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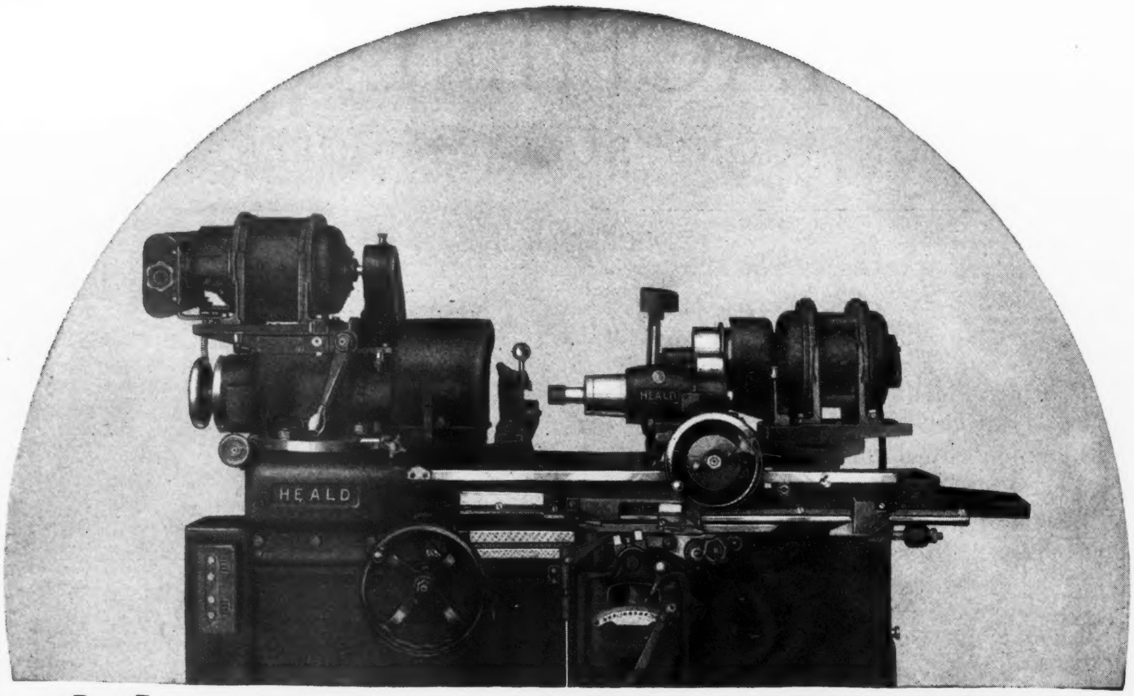

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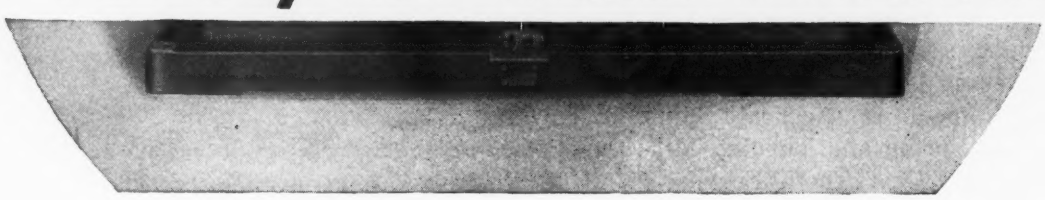

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HEALD MACHINE COMPANY, WORCESTER, MASS., U. S. A.

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MACHINERY

Volume 36 NEW YORK, DECEMBER, 1929 Number 4

Curtiss-Challenger Master Rods Made by Quantity Production Methods

Important Operations in Producing Master Connecting-rods for Engines of the Type Used on the Record-breaking St. Louis Robin

By CHARLES O. HERB

EVERYONE interested in the advancement of aviation hailed the feat of the *St. Louis Robin,* last summer, in shattering all previous endurance records. This remarkable performance of remaining 420 hours, 21 minutes, and 30 seconds (two and one-half weeks) in the air without landing, still stands as the world's record. While this accomplishment was due in large measure to the courage and stamina of the pilots, Jackson and O'Brine, credit also should be given to the engineers and skilled workmen who have developed the airplane and its engine to the point that makes such performances possible. Tests conducted on the engine at the end of this flight showed that the pulling power had not been reduced and that wear on the working parts was negligible.

The *St. Louis Robin* was fitted with the Challenger radial-type air-cooled engine manufactured by the Curtiss Aeroplane & Motor Co., Inc. This engine has six cylinders, offset alternately to permit the use of two master connecting-rods for driving the crankshaft. At 1800 revolutions per minute, the engine develops 170 horsepower.

Quantity production methods are employed in producing the Challenger engine in the Buffalo plant of the company mentioned, which has recently been erected for the exclusive purpose of building airplane engines. The floor space comprises 420,000 square feet—approximately ten acres. There are more than 700 modern machine tools with individual motor drives installed in this plant.

This article will describe some of the most interesting operations involved in the process of transforming rough master connecting-rod forgings, such as shown at the left in Fig. 1, into the finished part seen at the right. During this process sixty-three separate operations and inspections are performed, and about 20.5 pounds of metal are removed, the finished rod and cap together weighing 6.51 pounds.

All Forgings are Carefully Checked for Physical Defects before Annealing

The master rods are made from S. A. E. 2340 steel forgings. When these forgings arrive at the

plant they are first given a careful inspection for physical defects, and are then annealed, after which they are again inspected and tested for hardness, which must be between 331 and 388 Brinell. They are next sand-blasted to remove loose scale.

The first machine operation consists of rough-milling the faces of both the crankpin and piston-pin bosses on a "Mil-Waukee-Mil." The milling is done on two rods at a time by the use of three right- and left-hand helical slab mills, as shown in Fig. 3. By turning the rods end for end in the fixture with each traverse of the machine table, one rod is completed at each table movement. About 1/8 inch of stock is removed from each side of the rods, approximately 1/32 inch of stock being left for finishing. The feed is at the rate of 2 inches per minute.

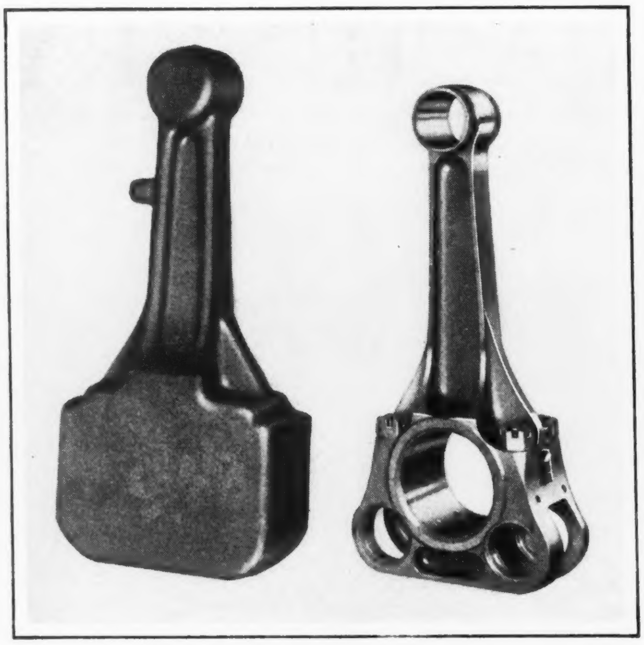


Fig. 1. Master Connecting-rod in the Rough and Finished Stages

At the end of the rough-milling operation, a 2 7/16-inch hole A, Fig. 2, is drilled through the crankpin boss, and then this hole is reamed to 2.500 inches within $\pm$ 0.001 inch. The piston-pin hole B at the opposite end of the rod and the two wrist-pin holes C for the articulating rods are next drilled and reamed. These operations are conducted in upright drilling machines with the rods held in jigs to insure the required accuracy.

Profiling the Rods by the Use of a Hinged Fixture

The profile of the rods on sides H and J, Fig. 2, is milled from the piston-pin boss to the large crankpin end in the operation illustrated in Fig. 5, which is also performed on a "Mil-Waukee-Mil." Two helical milling cutters remove the stock from two rods as the rods are raised and lowered to suit their contour, during the movement of the machine table. Raising and lowering of the rods is accomplished by the use of a fixture that is hinged at the left-hand end to permit vertical movements of the opposite end as former bars A pass over rollers during the traverse of the table. These rollers are positioned directly under the axis of the cutter-arbor.

After the profile has been milled on one side of a rod, the part is quickly turned over and reclamped

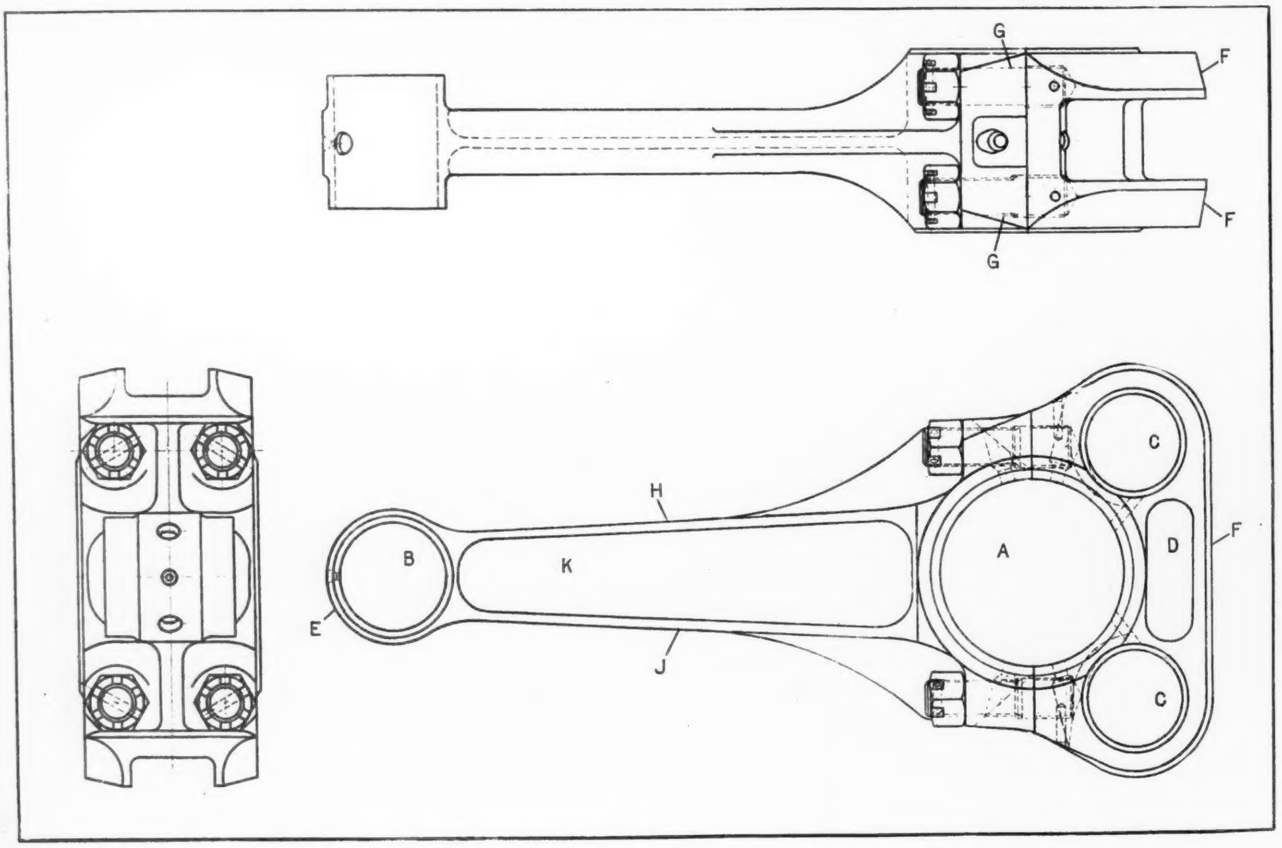


Fig. 2. Construction of Master Connecting-rod, Two of which are Used in Curtiss-Challenger Airplane Engines

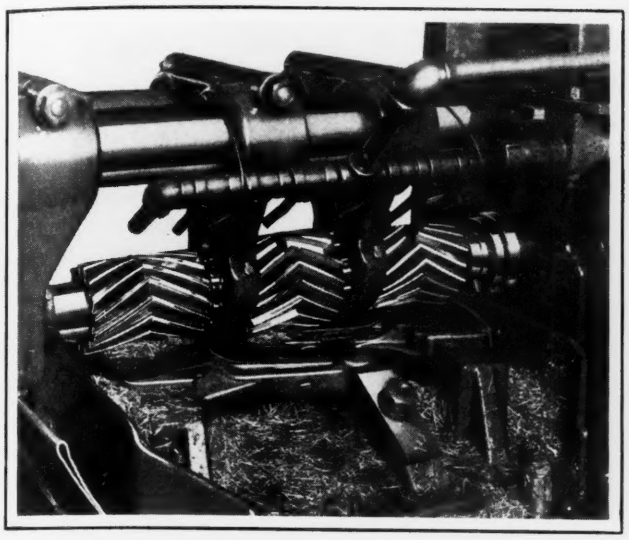


Fig. 3. Slab-milling Faces of Crankpin and Piston-pin Bosses

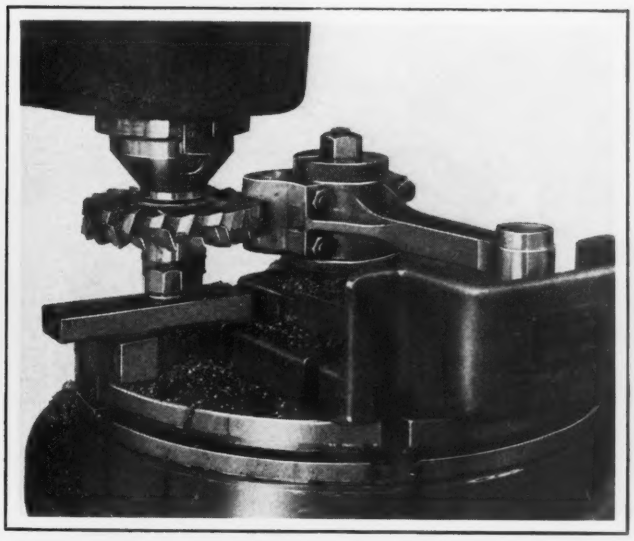


Fig. 4. Typical Operation on a Vertical-spindle Milling Machine

for milling the second side, one rod being completely profiled at each pass of the table. The depth of stock removed varies along the cut, at one point being about 3/4 inch. Approximately 0.005 inch of stock is left along each profile to be removed in polishing.

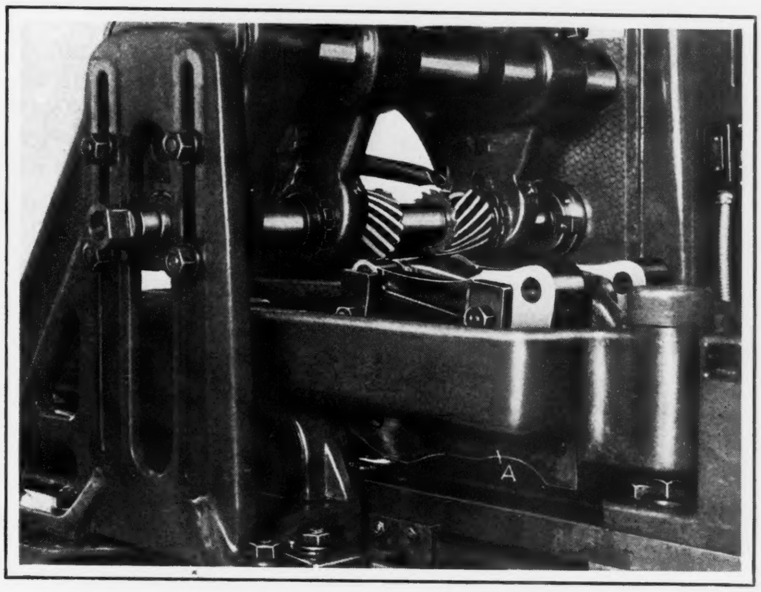


Fig. 5. Profiling Two Master Rods by the Use of a Vertically Swinging Fixture

A machine similar to that used in the operation just described is employed for milling the profile at the crankpin end. Two rods are milled simultaneously with the set-up shown in Fig. 8. In this operation, two milling cutters formed to the outline of the rods are used, the rods being located in the fixture parallel to the axis of the cutter-arbor. After one side of a rod has been milled, the part is placed on the opposite side of the fixture for completing the operation. This is a rough-milling oper-

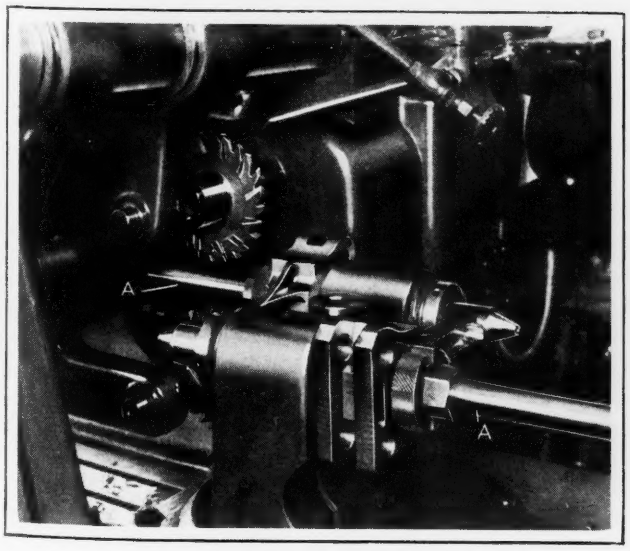


Fig. 6. Splitting the Cap from a Master Rod Proper by Employing Two Milling Cutters

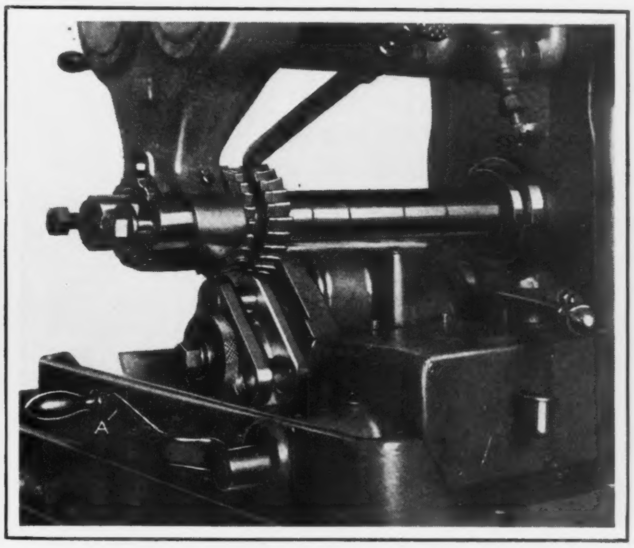


Fig. 7. Milling around the Bosses of the Articulating Rod Wrist-pin Bearings

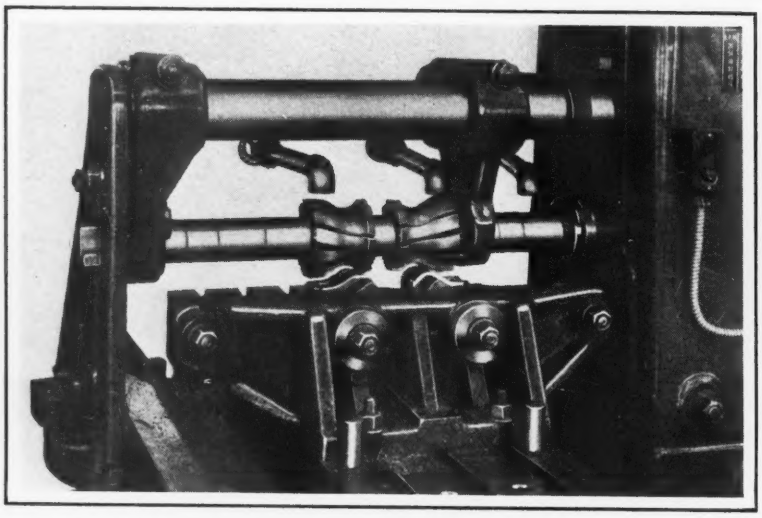


Fig. 8. Form-milling the Crankpin End of Two Master Rods

ation, approximately 1/32 inch of stock being left for finishing.

Channeling Two Rods at One Time

After the arms have been milled on the sides, channels *K*, Fig. 2, are cut in both sides of two rods at the same time by the use of fish-tail cutters, as shown in Fig. 9. When the fixture is being loaded, the rods are placed directly beneath the cutters, and after the rods have been clamped, the table is raised until the revolving cutters have been fed a depth of 3/8 inch into the solid arms. Then the longitudinal feed of the table is engaged, which automatically carries the rods back and forth beneath the cutters.

It will be observed from Fig. 2 that the width of the channels increases toward the crankpin end, which necessitates either moving the work transversely relative to the tools during the operation or moving the tools relative to the work. Thus, the work-holding fixture is so arranged that by turning handwheel *A*, Fig. 9, the fixture blocks on which the rods are mounted are swiveled about the centers of the piston-pin holes. The amount of sidewise movement is confined by stops to that necessary for obtaining the correct channel width.

The lower ends of the cutters are rounded to the same radius as the fillets at the bottom of the channels. The channels are cut into both sides of the arms by simply reversing the rods in the fixture. In this operation, both rough and finish cuts are taken. The two small slots *D*, Fig. 2, are produced in a similar operation.

Operations Performed on Vertical-spindle Milling Machines

Several operations are performed on a "Milwaukee" vertical-spindle milling machine, both in the preliminary and final stages of machining the rods. Fig. 4 illustrates one of these operations after the cap at the crankpin end has been cut off and temporarily reassembled by studs. Another of the operations consists of milling contour *E*, Fig. 2, of the piston-pin boss to the desired outline, by swiveling this surface relative to the cutter through the use of the rotary table with which the machine is equipped. The entire width of this boss is milled in the roughing operation, but in taking finishing cuts after the rods have been heat-treated to relieve the internal strains, the smaller diameter hubs are produced to a width of 3/8 inch.

In the operation illustrated in Fig. 4, the crankpin end of a master rod is being swiveled relative to the cutters for finish-milling the slots that receive the articulating rods. Two interlocking cutters are employed. These articulating-rod slots are rough-milled from the solid in a horizontal-spindle milling machine, 1/32 inch of stock being allowed for the finish. Then a semi-finish operation is performed, similar to that illustrated in Fig. 4, with the exception that two work-holding fixtures and three cutters are employed. In this operation, not only are the articulating-rod slots milled, but the adjacent bevel surfaces of ends *F*, Fig. 2, are also machined by means of right- and left-hand angular cutters which straddle the slotting cutter.

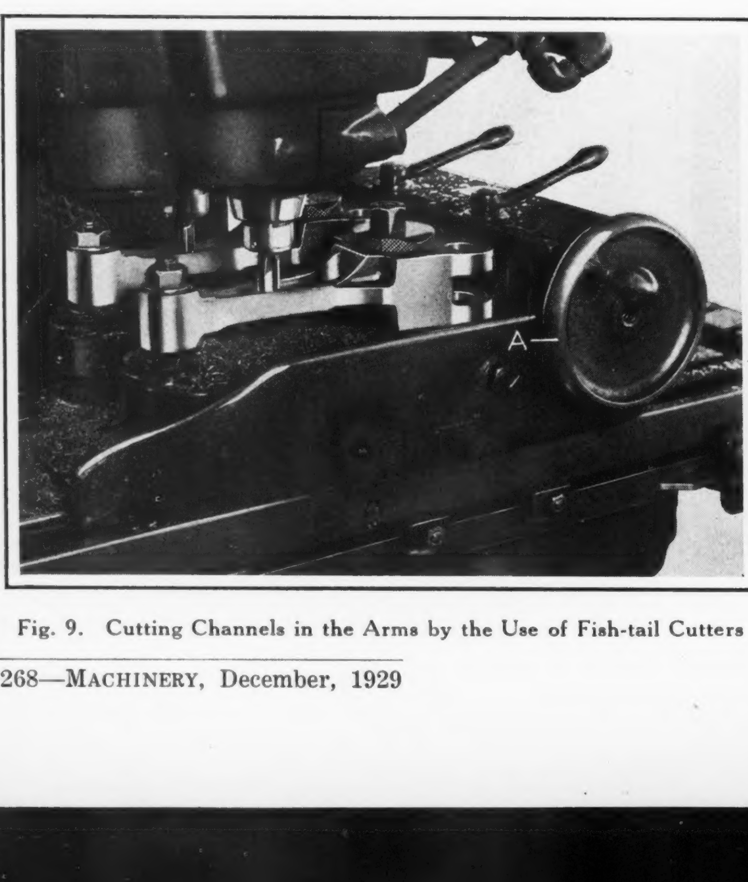


Fig. 9. Cutting Channels in the Arms by the Use of Fish-tail Cutters

Splitting the Cap from the Master Rods

Prior to the heat-treatment just referred to, the crankpin hole *A*, Fig. 2, which is drilled and reamed in preliminary operations on the rods, is bored 1/2 inch off center on one side to produce an elongated hole which allows for splitting off the cap. In this operation, the boring tool is guided accurately by a long bushing above the work. The rod is then heat-treated, after which a spot is polished on one side to permit the hardness to be rechecked by the Brinell method.

All finished surfaces of the channel and web are next sand-blasted to produce a frosted appearance. Immediately after-

ward, one face of the crankpin end is rough-ground on a Blanchard machine for locating purposes in future operations. A number of rods are loaded on this machine at one time.

The cap is next cut from the master rod proper in an operation illustrated in Fig. 6. For this operation, each rod is located from the piston-pin and crankpin bearings. The cutters are mounted on arbors above and below the work to sever the cap at one movement of the work-table. These cutters are 7/16 inch wide. Accurate guiding and rigid support of the work during the cut are insured by pilots *A* entering a bushing in the cutter-head of the machine.

The work-holding fixture is of a two-station indexing design, so that one rod can be loaded while the cap is being cut from another. The pilots also correct any possible errors in indexing the fixture. On one side of this fixture there is a finished flat surface which is used in connection with a feeler gage for setting the cutters accurately in or out on their arbors.

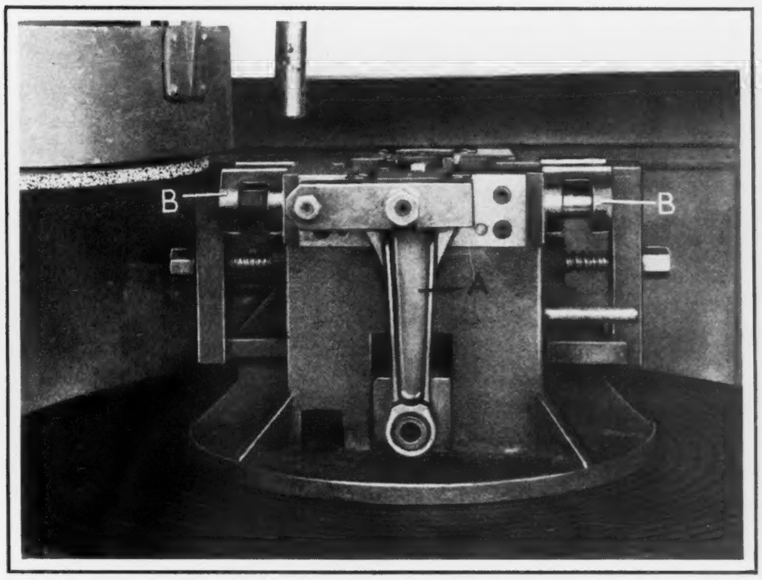


Fig. 10. Surface-grinding the Joint Surfaces of Master Rods and their Caps

Grinding Various Flat Surfaces

Fig. 10 shows the clamping faces of both rods and caps being finish-ground on a Blanchard automatic surface grinder. Two rods and two caps are mounted on opposite sides of the fixture, as illustrated at *A* and *B*, and ground simultaneously. The caps are located from the articulating rod wrist-pin holes, while the rods are located from the piston-pin hole and squared up with the crankpin half-bearing. There is a finished pad on top of the fixture that serves as a reference point in setting the grinding wheel for height with a 0.015-inch feeler gage.

This grinding machine is employed in a later operation for finish-grinding the crankpin bosses to length within $\pm$ 0.001 inch, eight rods being ground at one time. Then the piston-pin bosses are also ground to length within the same limits. Separate fixtures are provided for these operations.

Drilling and Reaming the Rod and Cap Stud Holes

The twenty-four-spindle Foote-Burt drilling machine shown in Fig. 12 is employed for drilling, counterboring, countersinking, and reaming stud holes *G*, Fig. 2, in rods and caps held vertically on a fixture, as shown at *A* and *B* in Fig. 12. It will be seen that this fixture is of the four-station indexing type. At the front of the machine the parts are loaded; at the second station four holes are drilled in both the rod and cap; at the third station, two of the rod holes are counterbored, while the two remaining rod holes and the four cap holes are countersunk; and at the fourth station, all rod and cap holes are finish-reamed. One rod and cap are, of course, completed at each indexing. The center distances between all holes are held within $\pm$ 0.001 inch.

Fig. 13 illustrates a convenient method of spot-facing around the four stud holes of the rods simultaneously by employing one spindle of a two-spindle drilling machine built by the Barnes Drill Co. This main spindle is equipped with a four-spindle head to permit the use of Eclipse tools. By merely turning the ratchet arrangement at the upper end of the shanks, the tools can be readily adjusted for height. Two of the stud holes reamed in the preceding operation are seated over dowel-pins to bring all holes into line with the cutters.

The holes in the caps are accurately threaded under the second spindle of the machine, using the set-up shown in Fig. 14. Unusual care is taken in tapping these holes, as the stripping of a stud thread when an airplane is in service may mean

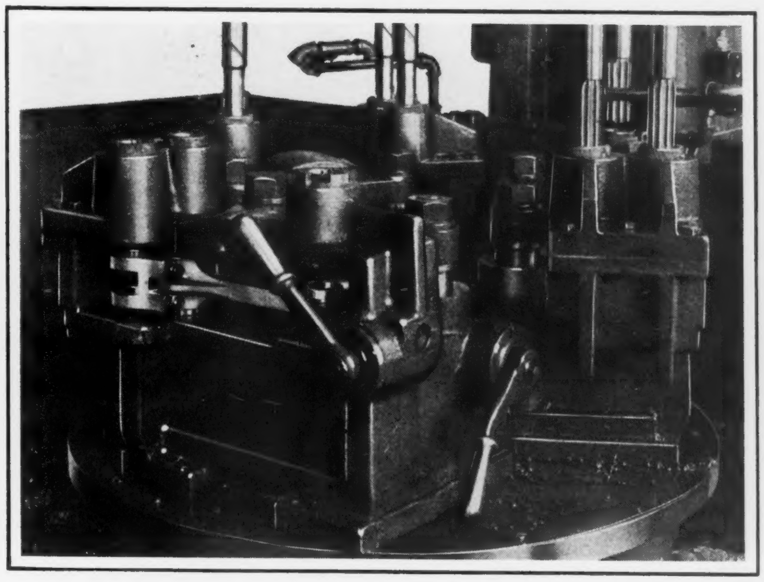


Fig. 11. Drilling and Reaming the Wrist-pin and Piston-pin Bearings

the loss of lives. Hence the cap is guided by a thread on master screw *A*, which is about 1 1/2 inches in diameter. With this arrangement, any possibility of the operator "crowding" the tap is eliminated.

The work is rough- and finish-tapped to a depth of about 1/2 inch on this machine. The taps are 1/2 inch in diameter, and have twenty threads per inch.

The fixture is designed to slide on ways both lengthwise and crosswise, so that the two holes of a cap can be positioned quickly beneath the tapping spindle, and when one cap is finished, the holes of the second piece can be positioned with the same ease. A plunger serves to locate each hole accurately. The threads of these stud holes are given a final hand-tapping before the caps are assembled on the rods.

After the stud holes of the caps have been tapped, the rounded portions of surfaces *F*, Fig. 2, are finish-milled on a "Mil-Waukee-Mil" equipped as shown in Fig. 7. In this operation, handle *A* is revolved to swivel the cap past the four cutters at the required radius.

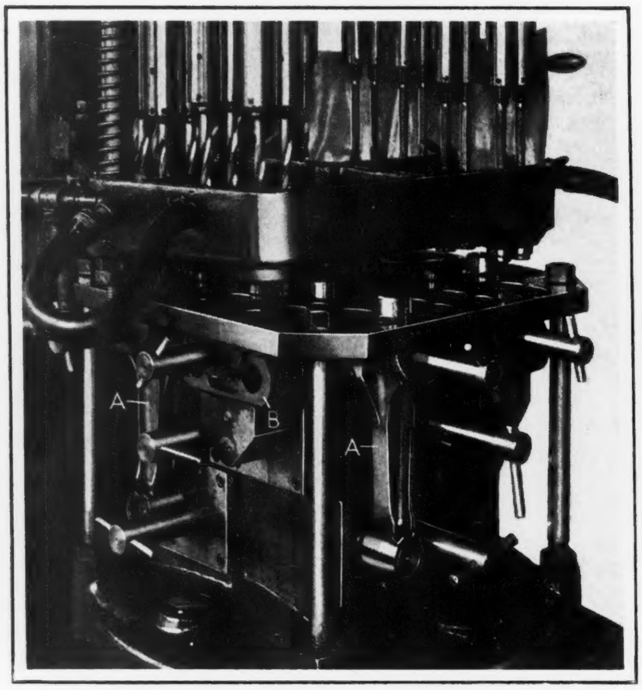


Fig. 12. Producing the Stud Holes in Master Rods and Caps

Finishing the Crankpin, Piston-pin and Wrist-pin Holes

When the caps have been temporarily reassembled on the master rods, the crankpin hole is finish-bored in a Gisholt turret lathe, which also finish-faces one side of the crankpin end, turns a boss on that side, and countersinks the adjacent edge of the crankpin hole. In a second operation on a similar machine, the opposite side of the crankpin end is finish-faced and turned. Both wrist-pin holes *C*, Fig. 2, are counterbored, countersunk, and recessed in a similar machine.

Then the piston-pin hole *B* and the two wrist-pin holes are bored and reamed to size within ± 0.001 inch in the Foote-Burt six-spindle machine illustrated in Fig. 11, which is equipped with a three-station fixture.

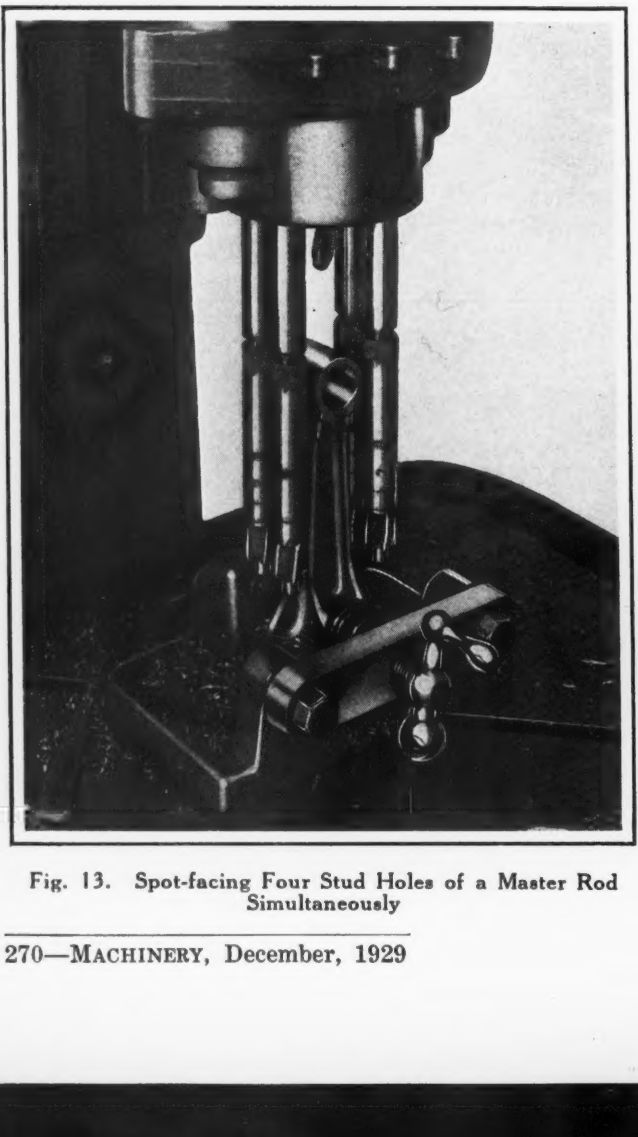


Fig. 13. Spot-facing Four Stud Holes of a Master Rod Simultaneously

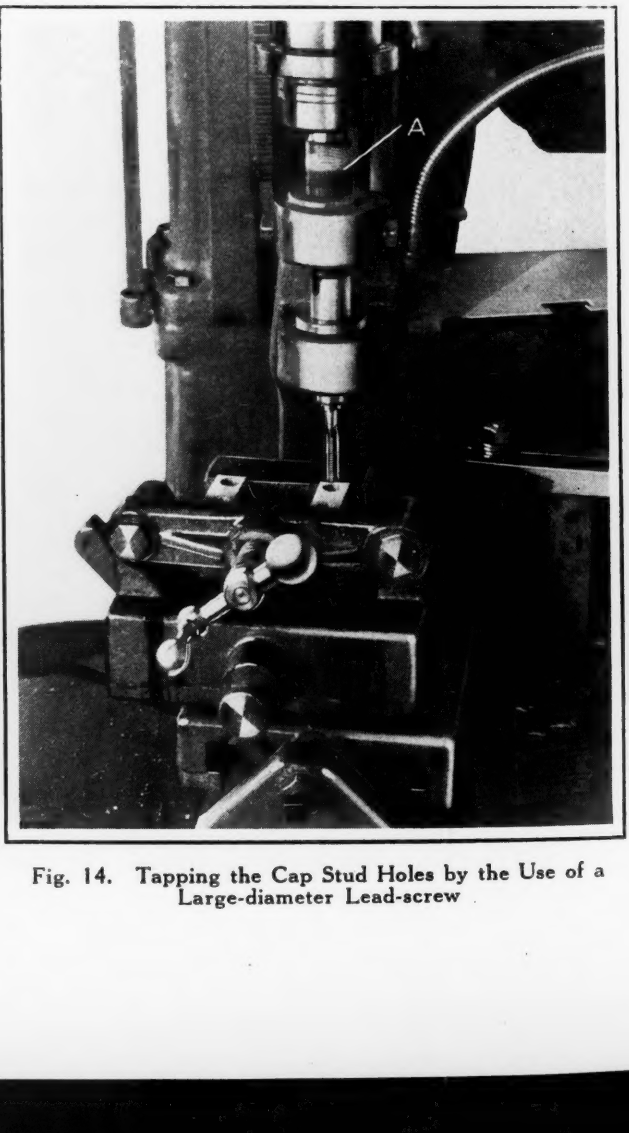


Fig. 14. Tapping the Cap Stud Holes by the Use of a Large-diameter Lead-screw

After various other operations have been completed, the temporary cap studs are removed and the caps are permanently assembled on the rods. Then the piston-pin, wrist-pin, and crankpin holes are ground successively in Heald "Sizematic" grinding machines; the operation on a wrist-pin hole is illustrated in Fig. 15. The limits on the wrist-pin and crankpin holes are $\pm$ 0.0005 inch, and the limits on the piston-pin hole are + 0.0005 inch or — 0.001 inch.

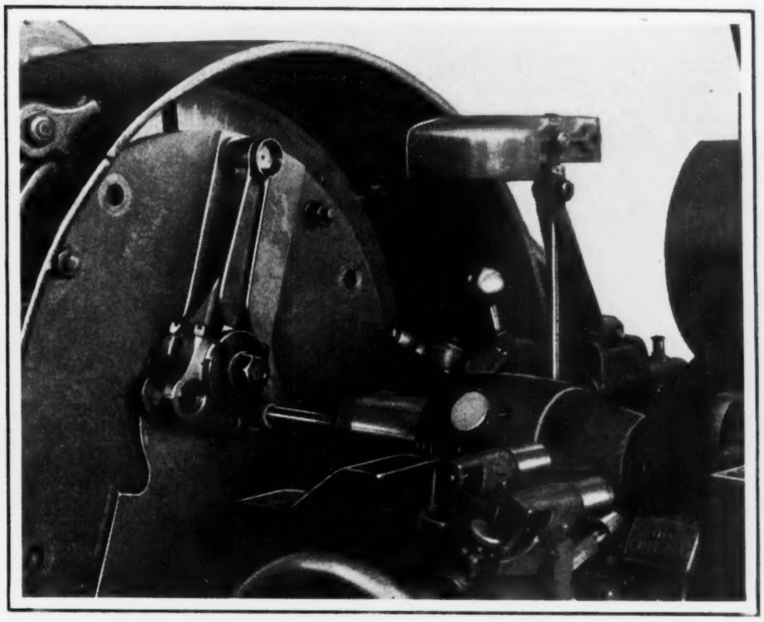


Fig. 15. One of the Grinding Operations Performed in Finishing the Different Bearing Holes

Before the master rod units are delivered to the assembly division, they are polished and carefully inspected to insure that the piston-pin hole is properly aligned with the crankpin hole in both parallel and right-angle planes. Similar important inspections are conducted. Bronze bushings are later assembled in the various holes and diamond-bored to give them an accurate and smooth finish.

Fig. 16 shows a general view of the master rod department from the end where the roughing operations are performed. Two of the vertical milling machines referred to may be seen at the left, while in the background are single-spindle and multiple-spindle drilling machines used in producing crankpin, piston-pin, and wrist-pin holes.

* * *

The factory cost of airplane engines per horsepower is much less than that of marine engines and about the same as that of railroad locomotives, according to George J. Mead of the Pratt & Whitney Aircraft Co. He states, in a paper read before the Milwaukee Section of the Society of Automotive Engineers, that airplane engines cost about \$18 per horsepower, as against \$145 per horsepower for marine (steam or Diesel) engines, while a locomotive costs about \$20 per horsepower, including the tender. The airplane engine will run without overhauling for 30,000 to 50,000 miles, compared with 30,000 miles for marine engines, 100,000 for locomotives, and 10,000 for automobiles.

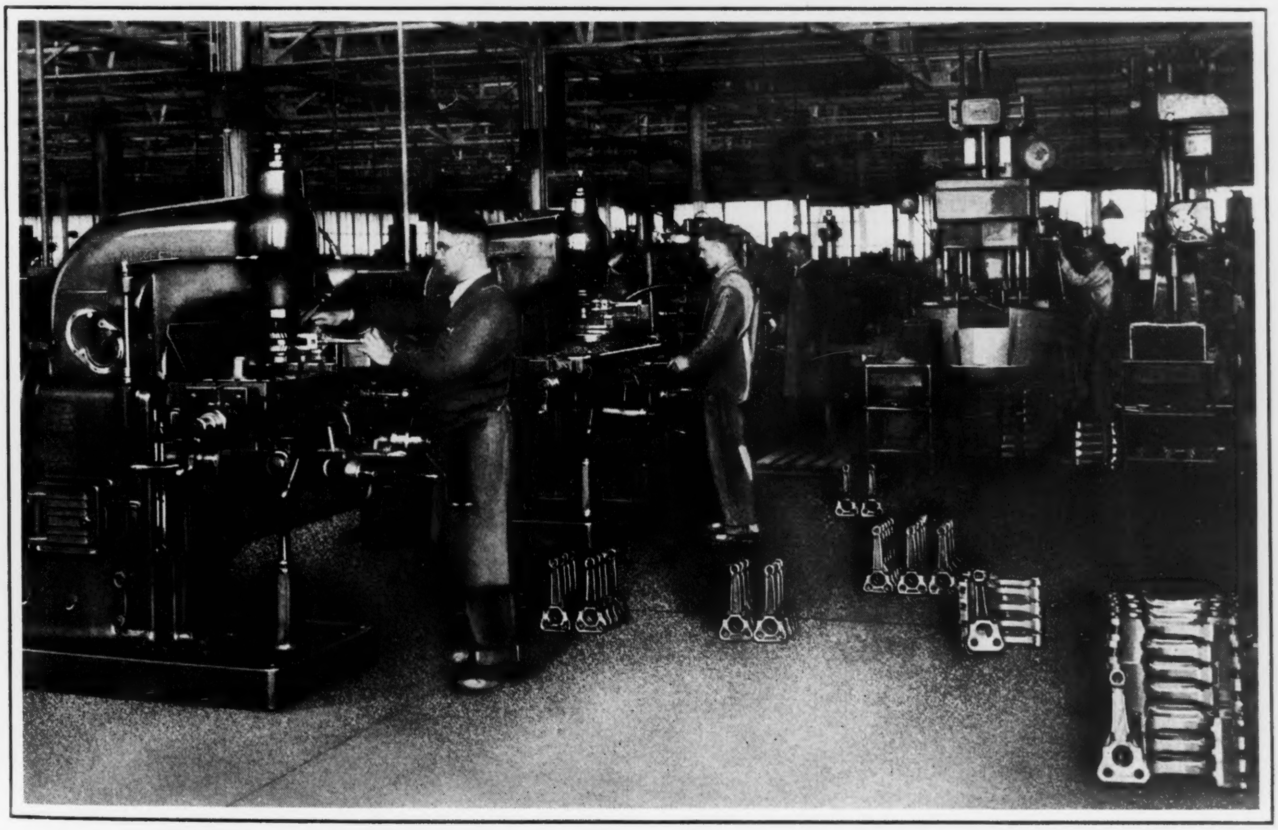
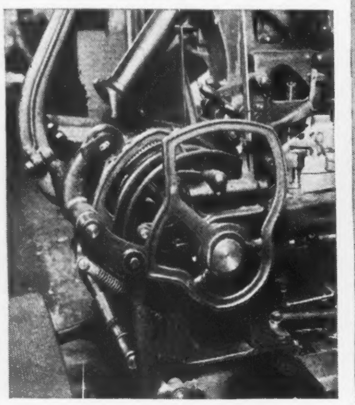
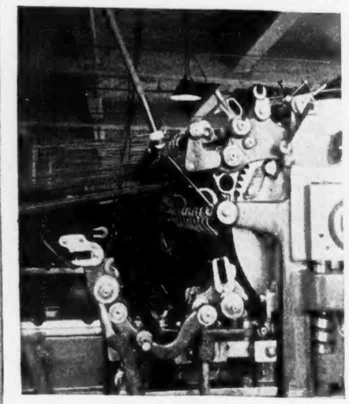


Fig. 16. A General View in the Department where Master Connecting-rods are Made by High-production Methods



Ingenious Mechanical Movements



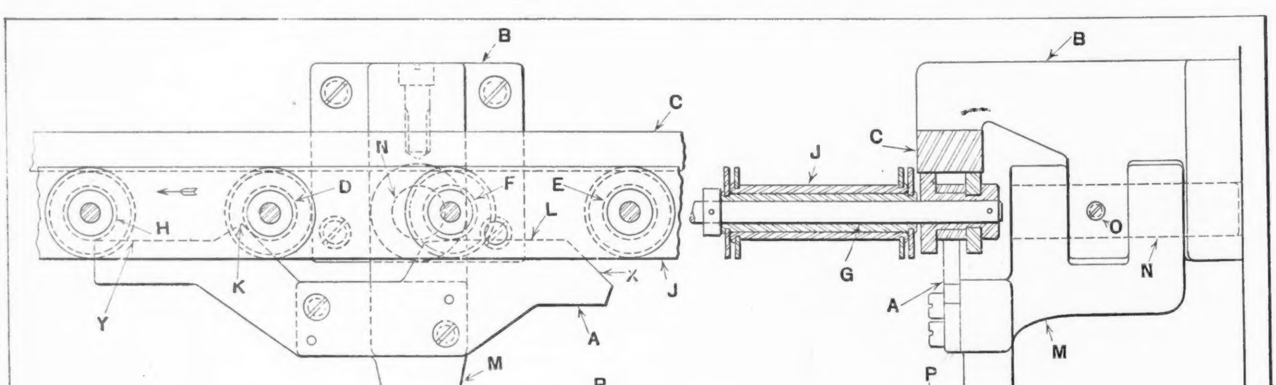
INTERMITTENT RECIPROCATING MOTION

By J. E. FENNO

It is often necessary to obtain a positive reciprocating motion, followed by a period of dwell, from a moving chain such as is used on lacquering machines. These chains carry a freshly lacquered part on each link as they pass through drying ovens. Such a motion can be imparted by each link of the chain with the device shown in the illustration; or by omitting certain cam-rolls, the device can be made to operate only as sections of the chain pass it.

Referring to the illustration, the chain *J* is constructed of flat steel links which are joined together by two lengths of tubing, one within the other, in a way to permit a free turning action at the link joints. Each link is equipped with a spindle *G*, the top end carrying the work-holder (not shown) while at the lower end is mounted a set of three rolls. The smallest roll is a slip fit on the hub of one of the larger ones and acts against the flat cam *A* when the chain is in motion. The two larger rolls come in contact with the bar *C*, thus providing the necessary support for the chain while under the action of the cam. The cam is fastened by screws and dowels to the swinging arm *M*, which is pivoted in the bracket *B* by the pin *N*, held in the bracket by the set-screw *O*. The bracket is secured to the machine table by screws, the supporting bar *C* being mounted on its upper part. There are also two other plain brackets (not shown) to support the extreme ends of this bar. Connected to a projection on arm *M* is the link *P* which carries the reciprocating motion to the required part of the machine.

In operation, the roll *D*, as shown in the plan view, is about to force the point *K* of the cam away from the chain, and as the cam is pivoted on pin *N*, the end *L* will move toward the chain between the two rolls *F* and *E*. Upon further movement of the chain, edge *X* will come in contact with the roll *E*. At this time, the center of roll *D* has passed the point *K*, so that as roll *E* forces edge *X* away, point *K* swings toward the chain and between rolls *D* and *F*. The projection *Y* on the cam prevents the point *K* from swinging further than is shown toward the center of the chain. It is obvious that the cam is in action only during a movement of the chain approximately equal to the diameter of the cam-rolls, and as the projection to which link *P* is connected is integral with the cam, the motion of the latter, as described, will produce the required reciprocating movement of the link *P*.



Intermittent Reciprocating Motion, Produced by the Movement of a Chain Past a Cam

AUTOMATIC SAFETY CLUTCH FOR PUNCH PRESS

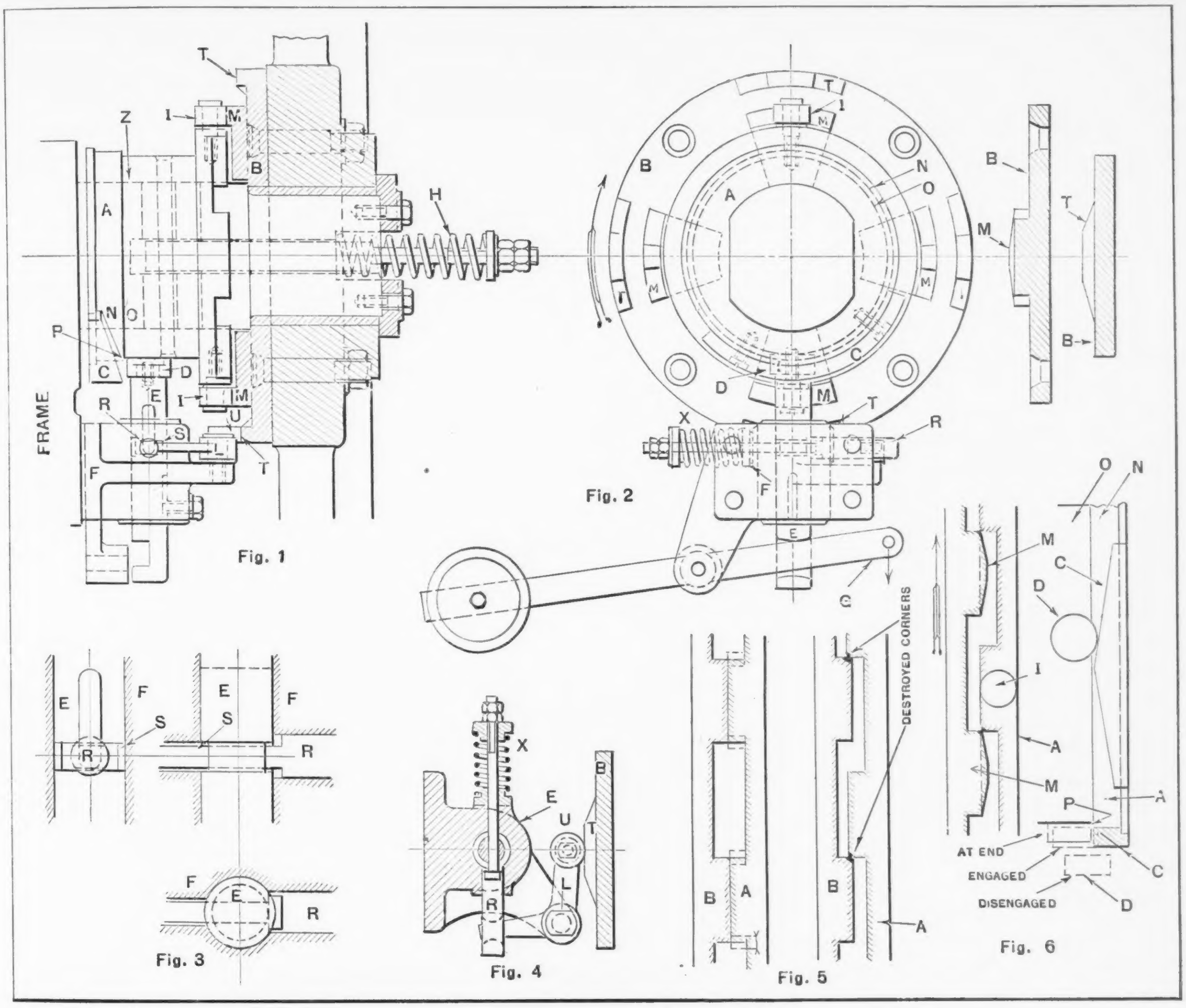
By RENE TILKIN, Liege, Belgium

The safety clutch shown in Figs. 1 and 2 of the accompanying illustration is used on punch presses operated by eccentric shafts which stop after each revolution at exactly the same position, so that the ram is returned to its original starting point. The toothed flange member of the clutch is secured to the main driving wheel, which revolves continuously. The toothed sleeve *A*, Fig. 1, which is brought into engagement with the toothed flange *B* on the driving wheel, to obtain a single working stroke of the press ram, is mounted on the eccentric shaft *Z*.

Sleeve *A* is a sliding fit on the eccentric shaft *Z*, but does not rotate on the shaft. Thus, when the teeth of sleeve *A* are engaged with the teeth of flange *B* on the rotating flywheel, the eccentric shaft *Z* will revolve with the flywheel.

Let us assume, for instance, that the clutch is engaged and that the press ram is on the upward stroke. The cam *C* on sleeve *A*, coming in contact with the roller *D* on the end of rod *E*, causes the sleeve *A* to slide to the left on shaft *Z* until the clutch is disengaged and the ram stopped at the point from which it started.

Now since the flange *B* rotates with the driving wheel, and the sleeve *A* remains stationary, the teeth of both clutch members will rub on one another if no provision is made to prevent this action. Also, excessive wear on the cam ring *C* and roller *D* may allow the sleeve to engage the flange at the wrong moment, which is likely to result in an accident. Means for preventing such an occurrence must, therefore, be provided.



Automatic Safety Clutch Mechanism for Punch Press

The clutch is engaged by pulling down the end of lever *G*, Fig. 2, in the direction indicated by the arrow. This action serves to pull the rod *E* downward, so that the cam ring *C* is disengaged from roller *D*, allowing the spring *H* to act and draw the teeth of sleeve *A* into mesh with the teeth of flange *B*. Now if lever *G* is pulled downward at the moment when the teeth of the sleeve are not in the proper position to mesh with those of the flange, seizing of the teeth at the edges, as indicated by the dark spots in the view at the right, Fig. 5, may take place.

This results in wearing off the edges to such an extent that the clutch will operate unsatisfactorily.

The wearing away of the edges is particularly dangerous, because it may prevent the clutch from being disengaged at the right time, as it permits the sleeve to be driven back without receiving any rotary motion. Under these conditions, the cam ring is no longer in contact with the roller and the tendency of the clutch to engage accidentally is far greater than before.

In order to eliminate the first fault referred to, that of continual rubbing together of the teeth on the two clutch members, the sleeve *A* is provided with rollers *I*, Fig. 1, which turn loosely on pivot studs. The flange *B* has four small cam surfaces *M* which project over the clutch teeth in such a manner that they make contact with the rollers *I* as soon as the clutch teeth are disengaged. The roller *D*, which was in contact with the face *N* of the sleeve, now comes in contact with the face *O* on the sleeve, which is smaller in diameter. Contact of roller *D* with the shoulder at point *P* keeps the sleeve in such a position that its teeth will clear the teeth of the flange *B* during the period in which shaft *Z* remains at rest.

The second disadvantage is overcome by providing a wedge *R*—see Figs. 2 and 3—which engages a groove *S* turned in the rod *E*. Wedge *R* prevents lever *G* from being operated when the teeth of sleeve *A* are not in the proper position with respect to the teeth of flange *B*. In order to prevent lever *G* from being operated except when the teeth are in the proper position, as indicated in the view at the left, Fig. 5, a right-angle lever or bellcrank *L*, Fig. 4, is provided which controls the movement of the wedge *R*. Lever *L* is operated by the cams *T* on the face of the flange *B*. These cams come in contact with the end roller *U* of lever *L*, as indicated in Fig. 4, and thus cause the wedge *R* to be withdrawn so that lever *G* can be pulled down.

As the teeth of flange *A* rotate past the proper position for meshing, cam *T*, Fig. 4, also passes out of contact with roller *U*, allowing the spring *X* to draw wedge *R* back into the blocking position. The details of wedge *R* and rod *E* are shown in the enlarged view, Fig. 3. The view at the right, Fig. 6, shows the profile of the clutch-disengaging cam *C*. The view at the left shows the profile of one of the cams *M*, which force the sleeve *A* back so that roller *D* can bear on the shoulder *P* and thus prevent the clutch teeth from rubbing together.

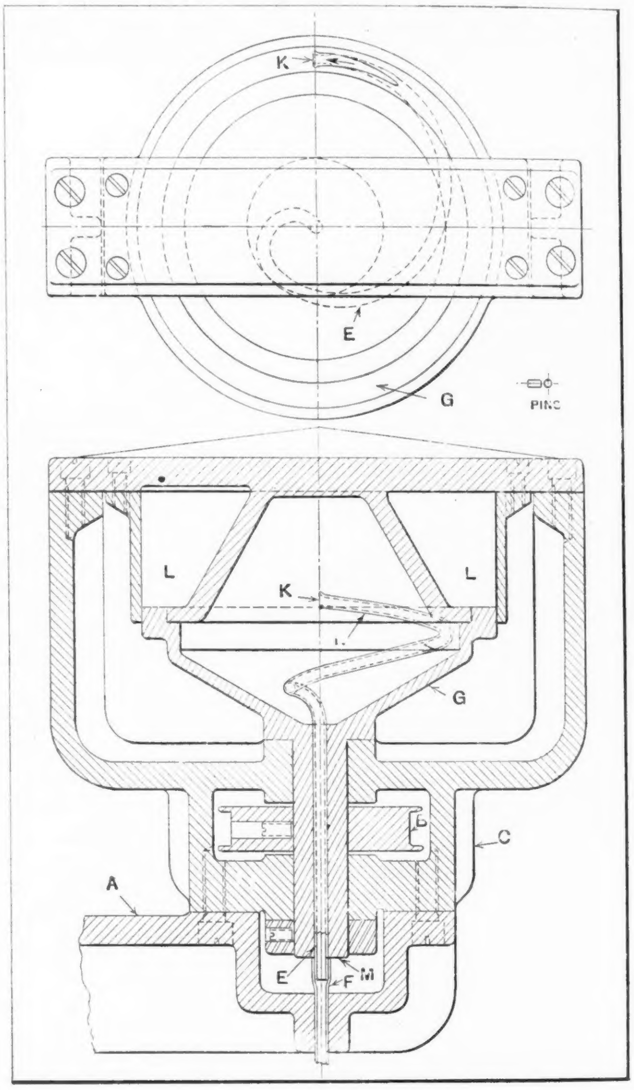
* * *

MECHANISM FOR FEEDING ROUND PINS TO A DIAL PRESS

By F. E. JUDSON

An unusual type of hopper for feeding round pins to a dial press is shown in the illustration. With this design, the open end *K* of the revolving conical coil of tubing *E* is continually passing through the mass of pins in the hopper reservoir *L*, some of which enter the tubing at *K* and slide both by gravity and by the pushing action of the pins entering, down the incline to the center of the coil where they pass into a stationary tube *F* leading to the press.

The bracket *C*, fastened by screws to another bracket *A* on the press, has two bosses which serve as bearings for the turned shank *M* on the revolving member *G*. The latter, driven by the flanged pulley *B*, which is connected by a belt to a pulley on the press crankshaft, serves as a holder for the coil *E*. The lower end of this coil is straight and passes down through the shank *M* into the swaged



Hopper with Revolving Coil of Tubing through which Pins are Fed to Dial

end of the stationary tube *F*, while the upper end of the coil passes at an angle through the face of the outer flange on the member *G*, as illustrated at *N*.

The hole for the tubing in member *G* at *N* is first cut through with an end-mill, and after the tube has been properly located, it is babbitted in place. The babbitt is next doweled to member *G* to complete the joint.

In this type of hopper, the length of the pins to be fed governs the diameter of the coil. Therefore it could not be used for very long pins, as the diameter of the coil would have to be so large as to be impractical.

Machine for Cold-bending Steel Pipe

Power-driven Machine for Cold-bending Steel Pipe into Hairpin Coils Such as Are Used for Water-heating Purposes

By PAUL H. WHITE

THE pipe-bending machine described in this article is employed in a plant where one or two carloads of pipe each month are worked up into continuous hairpin bends of the form shown in Fig. 1. Originally, the piping was bent to shape around cast-iron forms located at opposite ends of a heavy wooden bench. After a length of pipe was clamped against one of the forms, a lever, pivoted at the center of the form and carrying a roller that pressed against the pipe, was used to sweep the pipe around the form, the power being provided by three husky men. When the bend was completed, it was necessary to disconnect the lever in order to remove the pipe. The same operation was then repeated at the other end of the bench, using a form of different size.

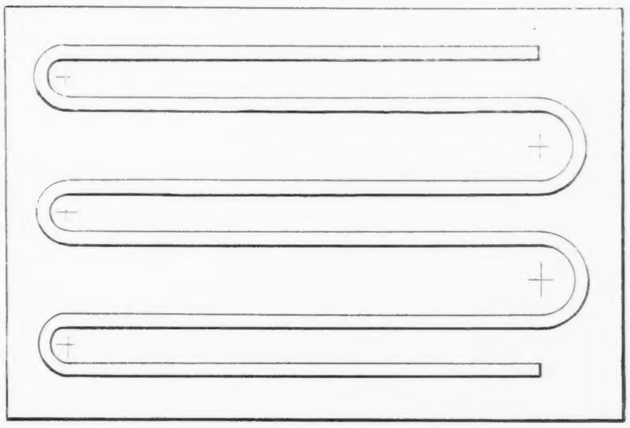


Fig. 1. Coil Made of Cold-bent Steel Pipe

In order to eliminate these tedious operations, machines like the one shown in Fig. 3 were designed. The first machine of this kind to be constructed has been in daily operation for the last five years. The framework is of structural steel, and the table top of steel plate. The bending forms are placed at opposite ends of the table, and are made right and left, that is, the pipe is bent around one form in a clockwise direction, and counterclockwise around the other. The forms are so located with relation to the top of the table that the pipe fits into the groove of the form when it rests on the surface of the table.

Operation of Bending Machine

The procedure in bending coils like that shown in Fig. 1 is as follows: The pipe is first placed in the groove in one of the bending forms and clamped with the proper length projecting from the end. The movement of the handle *D*, Fig. 3, serves to clamp the work in place. The lever *K* is then swung around into the position shown in the illustration,

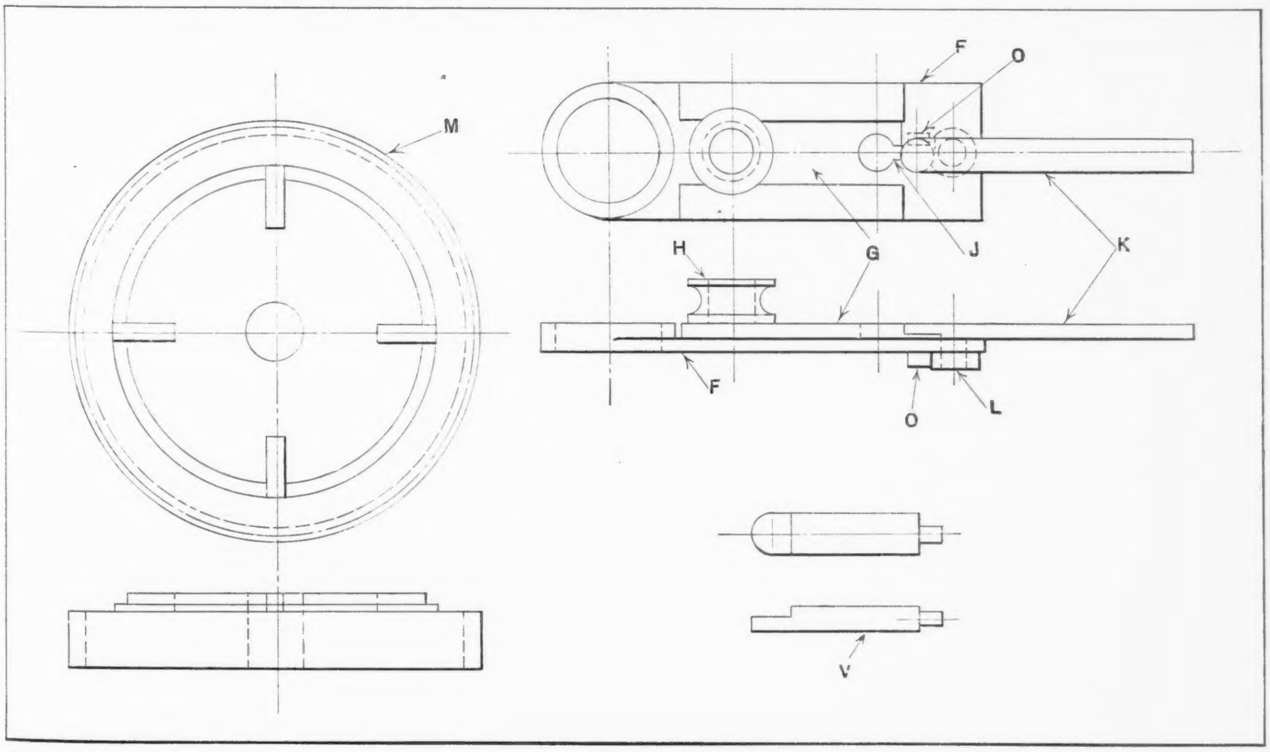


Fig. 2. Parts of Pipe Bending Machine Illustrated in Fig. 3

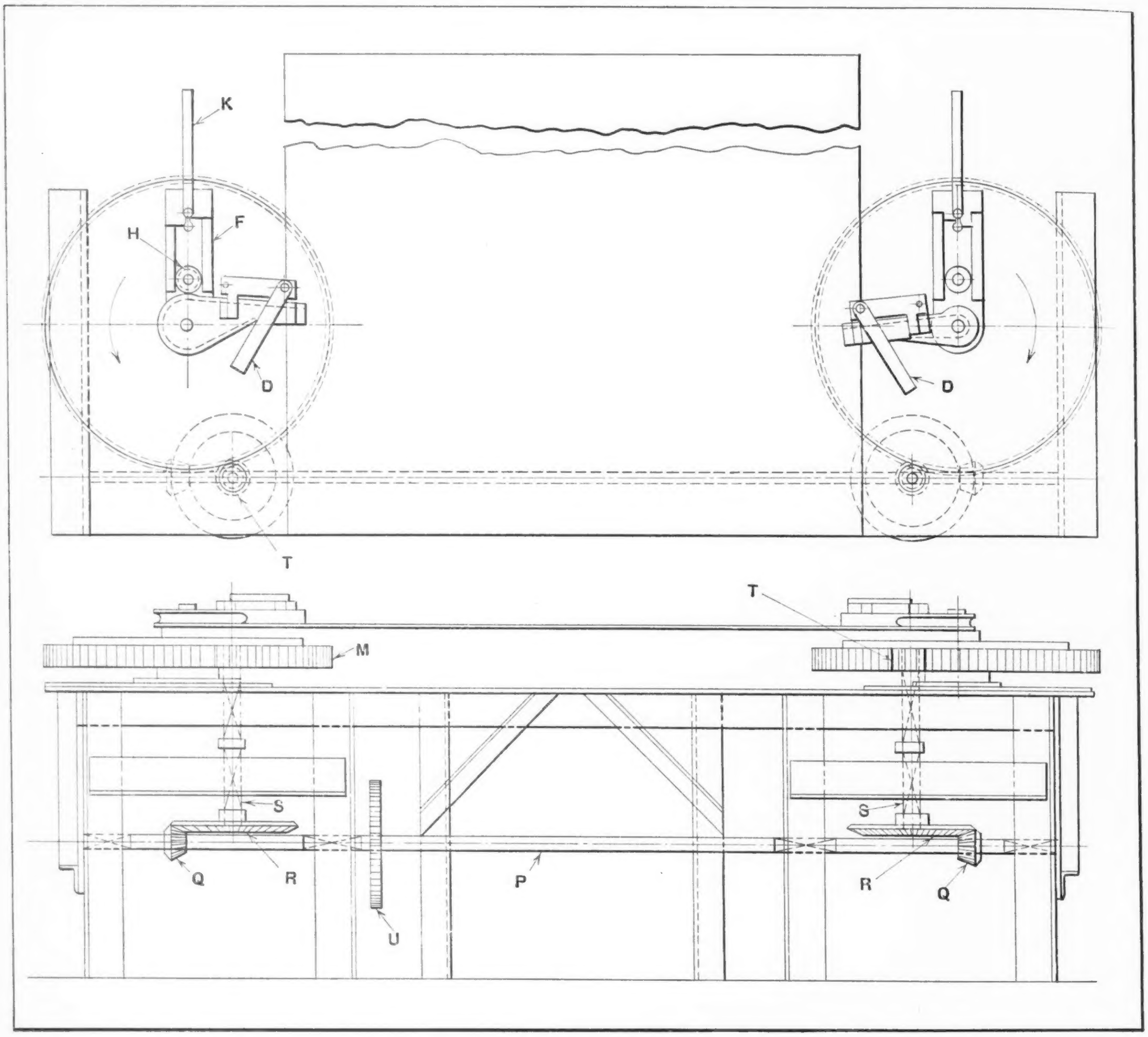


Fig. 3. Machine for Bending Coils Such as Shown in Fig. 1

causing arm F, which carries bending roller H, to engage a key on the continuously rotating gear M.

When arm F has been swept around through the required angle, the handle K engages a stop-pin which causes the driving key to be withdrawn, thus stopping the bending movement. The movement

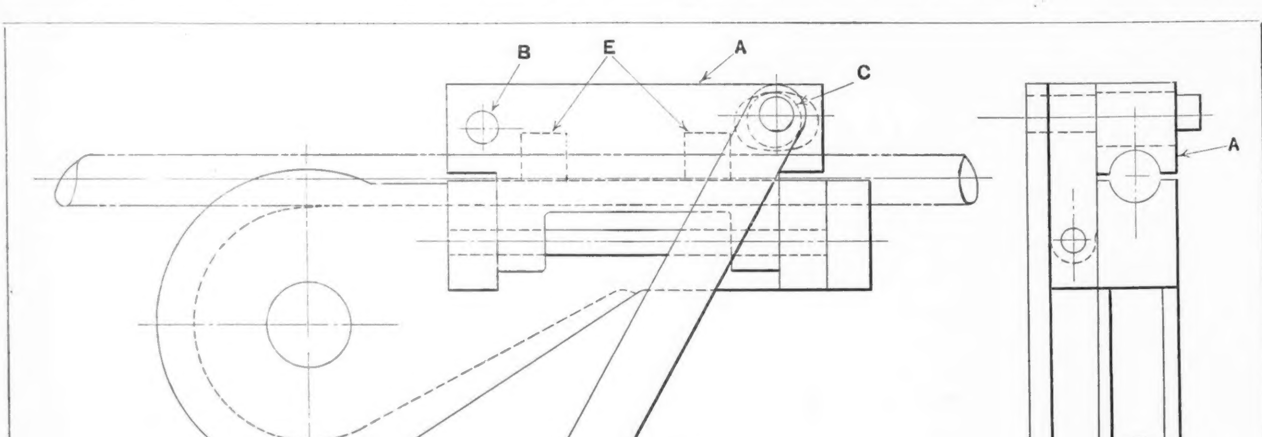


Fig. 4. Assembly of Clamp for Holding Pipe in Place on Bending Form

of lever K also withdraws the slide on which the roller H is mounted so that the bent pipe can be easily removed when the clamp is released.

Method of Holding Pipe

The assembly of the clamp which holds the pipe in place during the bending operation is shown in Fig. 4. The clamp hinges upon a pair of lugs at the top and near the front end of the bending form, and can be swung upward so that it will clear the pipe. The clamping is accomplished by the grooved bar A which pivots on the pin B and is actuated by eccentric C. The lower end of eccentric C terminates in a pin which fits into a hole in the table when the hinge is closed. A half turn of the eccentric by means of lever D forces the pipe into the groove and holds it tightly against the form. Two hardened steel jaws E are inserted in the grooved face of bar A and are adjusted by means of shims to compensate for wear.

How the Bending Mechanism is Controlled

The assembly of the bending mechanism is shown in Fig. 2. This consists of a base F carrying a slide G on which is mounted the grooved roller H. As mentioned, the slide is withdrawn by means of the lever K to permit the pipe to be removed after the bend is completed. The longitudinal movement of the slide is effected through the action of the toggle J and lever K. On the under side of lever K is a pin L which pivots in a hole in the base F. At the lower end of pin L is a cam which serves to disengage the keys V from contact with the driving pin O and thus stop the bending movement when lever K strikes the stop-pin.

Only a slight turn of the cam is required to force the driving key V back into its slot until it clears the driving pin O. Thus, the movement of lever K, which withdraws the roller slide, also disengages the drive to the bending arm. As long as the slide remains in its released position, the cam forces the driving keys V inward and prevents them from coming in contact with the driving pin. This arrangement permits the bending arm to be swung around to the starting position without interference from the continuously rotating gear M.

The main driving gear is shown at the left in Fig. 2. In Fig. 5 it is shown assembled on its spindle, together with the forming and bending mechanism. The vertical spindle N on which the spur gear is mounted also forms the pivot bearing for the bending mechanism, as well as the center on which the bending form is located. The four radial slots which form the seats for the driving keys V are cut in the top surface of the gear M.

The driving keys V, one of which is shown in the lower right-hand corner of Fig. 2, terminate

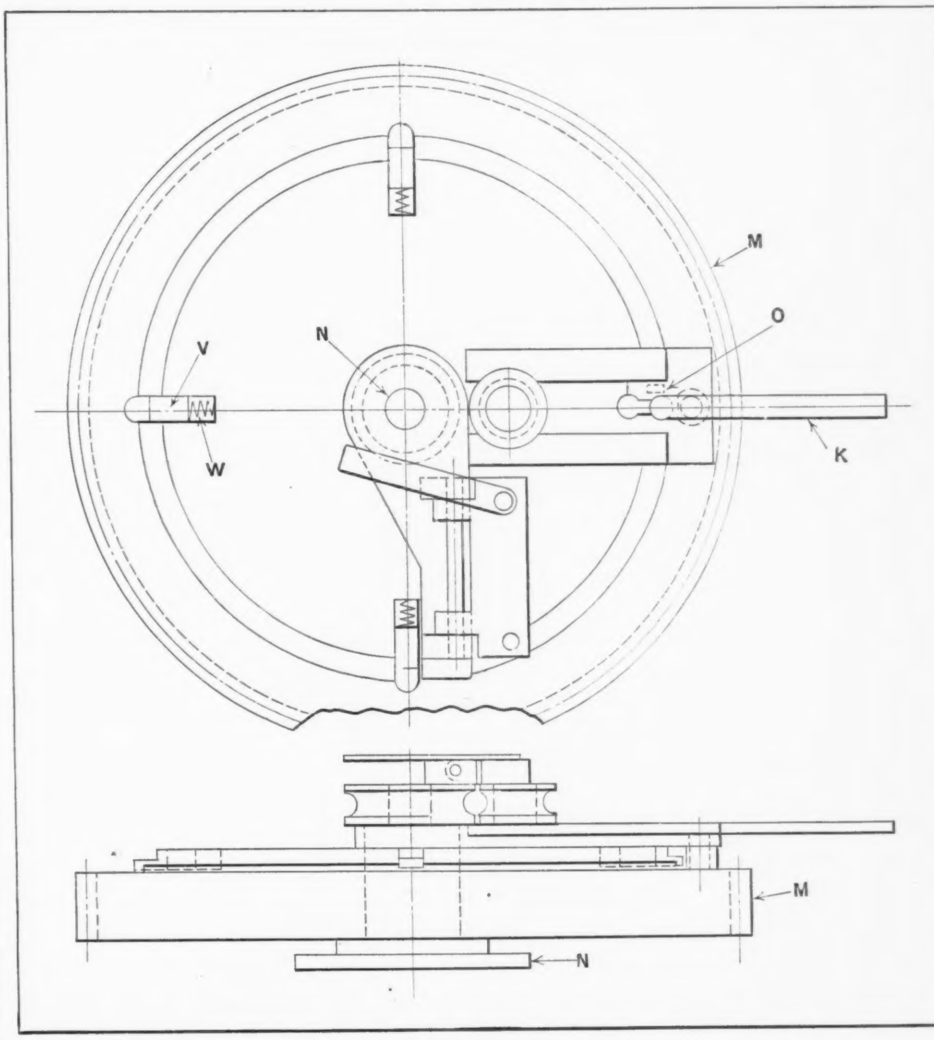


Fig. 5. Assembly of Clamping, Bending, and Driving-gear Members of Pipe-bending Machine

in a round pin at the inner end, which acts as a retainer for the spring W. The outer ends of the driving keys have a short length milled off to about half the depth of the keyseat, and this end is finished to a radius. It is this end that the cam on pin L, Fig. 2, engages when handle K is thrown over to withdraw the slide on which the bending roll is mounted.

Method of Driving the Two Bending Arms

The driving arrangement of the complete machine is best shown by the assembly view, Fig. 3. The drive shaft P carries two bevel pinions Q which engage bevel gears R, thus imparting rotation to the vertical shafts S. The spur gears T on

the upper ends of the vertical shafts engage the main gears *M*. Power from an electric motor is applied to the shaft *P* by a chain drive to the sprocket *U*. The lengths of the various coils are gaged by a stop-pin placed at a fixed distance from the face of each of the bending forms, so that the coils are all held to a uniform length. Although designed for one size of pipe, the machine could be readily adapted for handling other sizes by the provision of bending forms of the required size.

* * *

In an age of intensive specialization, there is a great tendency for everyone to become somewhat unbalanced on the side of theory. The modern designer must know a great deal, and the usual process of acquiring this knowledge is through systematic education. Systematic education has the fault of being formal, of dividing knowledge, and placing the parts into carefully selected pigeon-holes. This division of knowledge has grown out of the necessity of teaching the student a great deal in a relatively short time. Thus the student, by the same necessity, is not allowed time enough to study out the real significance of the pigeon-holes. Facing this elaborate system of knowledge, and not, as a rule, having had much practical experience, the student naturally acquires the idea that all life is systematized in the same way. That which in the practical life of the designer becomes a means to an end, is the end itself while the future designer is a student.

* * *

Another step toward the substitution of metal for wooden railroad ties has been taken by the application of welded metal ties to switches and crossovers on the Delaware & Hudson Railroad. This company also recently completed a rearrangement of the spur which connects its main freight line with the General Electric plant at Schenectady, and at that time all the old wooden ties were replaced by metal ties. Automatic welding machinery has been designed by the General Electric Co. for producing metal ties at a low cost; until recently, however, such ties have been used on straight track only. The latest installation at Schenectady includes all types of track commonly used in railroad service, with the exception of track involving signaling functions, on which development work is now in progress. The Delaware & Hudson Railroad has a metal tie fabricating shop at Colonie, N. Y.; this shop has an output at present of about 20,000 ties per year.

THE 1932 MACHINE TOOL EXPOSITION

At the annual meeting of the National Machine Tool Builders Association, at Briarcliff, it was decided to hold the next Show in 1932, which will be an interval of three years between the two. The new officers elected for the coming year were: Carl A. Johnson, Gisholt Machine Co., president; Howard W. Dunbar, Norton Co., first vice-president; Robert M. Gaylord, Ingersoll Milling Machine Co., second vice-president and director; Frederick V. Geier, Cincinnati Milling Machine Co., treasurer; Clayton R. Burt, Pratt & Whitney Co., director; and George E. Randles, Foote-Burt Co., director. Ernest F. Du Brul was re-elected general manager, and Mrs. F. M. Selbert, secretary.

Carl A. Johnson, New President of the National Machine Tool Builders' Association

Carl A. Johnson, the new president of the association, was born in Madison, Wisconsin, in 1870, and graduated from the University of Wisconsin as a mechanical engineer in 1891. During his vacation Mr. Johnson worked in the shops of the Gisholt Machine Co., which was founded by his father, John A. Johnson, and since 1908 has been president of the company. He has traveled extensively, both in this country and abroad, and has a wide acquaintance among manufacturers. Mr. Johnson is a director of the First National Bank of Chicago, the Cutler-Hammer Co. of Milwaukee, the Employers Mutual Insurance Co. of Wausau, and the Wisconsin Manufacturers' Association, of which he was also president for several years.

* * *

IMPROVED AIRPLANE-ENGINE COOLING

Many advantages appear to be available if a liquid cooling substance boiling at higher temperature than water and freezing at a lower point can be used generally in airplane operation. According to a paper presented by Gerhardt W. Frank, of the Material Division of the Air Corps at Wright Field, at the Cleveland aeronautic meeting of the Society of Automotive Engineers, some of these advantages are: Increase, in tests, of 10 per cent of an engine's fuel economy; reduction of radiator size to 30 per cent of what it must be with water cooling; an 11 per cent saving in engine weight; and a saving of 30 per cent of the volume required for cooling water.

An investigation conducted by the Air Corps with an ethylene-glycol solution called "Prestone" showed that the liquid proved harmless to all parts of the engine, except that it caused the lining of the radiator hose to swell.

Assembling Small Parts by Vibration

An Unusual Method for Rapidly Assembling Small Electrical Switch Parts by Shaking Them into Honeycombed Plates

By F. E. JUDSON

RAPID assembling of the component parts of the switch assembly shown at *A*, Fig. 1, is accomplished in the special vibrating machine shown diagrammatically in Fig. 2. In this machine, the parts are piled on plates provided with a great number of holes. The plates are given a vibrating motion, which causes the parts to drop by gravity into the holes. By removing the plates from the machine after they are filled, and combining them so as to allow parts in one plate to drop on or assemble with those in another plate, a great number of parts can be assembled simultaneously. The machine is belt-driven, and is equipped with three wooden bins, *B*, *C*, and *E*, each of which holds a large quantity of one of the switch parts. Bin *D*, which is not used, was added merely to produce a uniform construction.

The long bar *F* is a sliding fit in the end bearings, and is supported at the center by members *G*. The reciprocating or vibrating motion is imparted to bar *F* by the hexagonal cam *H*, the corners of which act against the end of the bar. The bar is kept in contact with the cam through the action of coil spring *I*. Four different sets of assembling plates are locked on the vibrating bar by the latch arrangement shown which permits them to be removed by the operator while the machine is in motion.

The plates used over bin *B*, which are shown in Fig. 3, consist of the honeycombed hard rubber plate *A* and the steel plate *B*. In order to make clear the action of the switch parts in the process of assembly, enlarged partial cross-sections of the plates are shown in Fig. 1. The operator piles the U-shaped pieces *H* on the plate over bin *B* in Fig. 2. As the closed end of the U-shaped piece is the heavier, it has a tendency to drop into one of the honeycombed holes, as shown at *B* in Fig. 3. When all the holes are filled, the plate is removed and replaced by another.

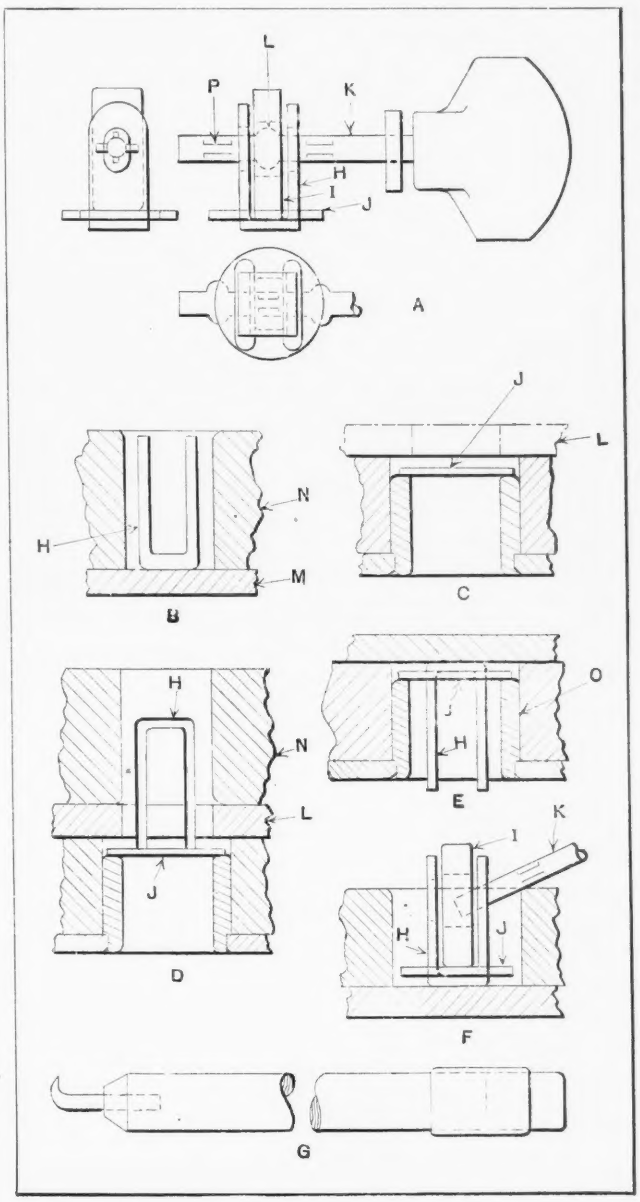


Fig. 1. Switch Part Assembly, Enlarged Cross-section of Assembling Plates, and Tool for Handling U-shaped Pieces

Over the next bin *C*, Fig. 2, the washers *J* are collected in a similar manner, as shown at *C* in Fig. 1. Next, plate *L* is placed over the plate holding the washers, as shown in dot-and-dash lines, after which the entire combination is inverted and placed on the plates shown at *B*, which have previously been filled with the U-shaped pieces. Then the new combination is inverted again, and plate *M* removed, as shown at *D*. The combination of plates carrying the U-shaped parts and the washers is placed on the vibrating bar over bin *D* in Fig. 2 until the legs of all the U-shaped pieces drop through the slots in the washers, after which they are removed from the machine, plates *L* and *N* replaced by a blank plate similar to *M* (see view *E*, Fig. 1), and the whole inverted and placed again in the machine over bin *E*, Fig. 2. Here the commutators *I*, Fig. 1, are assembled into the U-shaped piece by the vibrating motion.

The plate containing the bushings *O* is now removed, as shown at *F*, and the plates with the assembled parts are stacked and transferred to a power press. Here the operator removes the pieces

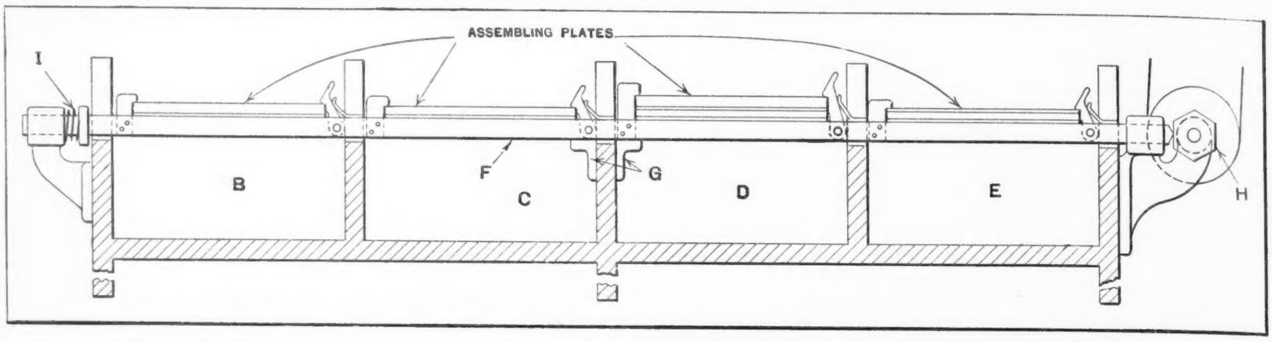


Fig. 2. Diagrammatical View of Vibrating Machine Used for Assembling Electrical Switch Parts

from the plate with a key *K*, inserting it through both U-shaped piece and commutator, as shown at *F*. Then the small end of the key is placed in the die and the raised portions *P* formed, completing the assembly. The hooked end of the tool shown at *G* is used to remove any U-shaped pieces that may enter the plates open end first, while the rubber-tipped end aids in forcing pieces with burrs on them through the washer.

All plates are doweled so as to make them interchangeable, the dowels being a drive fit in the thicker plates and a slip fit in the thinner ones. The drilling of these plates is done with a jig to insure close alignment of the different holes. The method described has also been used successfully in assembling small bullets and shells, and although seemingly complicated, is very simple in operation. It has increased the production approximately 200 per cent over the previous method of assembling each unit by hand at the press, and the idle time of the latter has also been reduced.

* * *

WHY DOES A FOREMAN GIVE FAULTY ORDERS?

In the opinions of the members of a recent foremen's conference, there are many possible explanations for the issuance of incorrect orders by a foreman. He may not be familiar enough with or sufficiently attentive to his own work to give correct orders to his men. He may interpret orders erroneously, or he may, himself, have received incorrect or incomplete orders. The trouble may be due to lack of the qualities of leadership, insufficient analysis of his work, faulty organization of his department, reliance on snap judgment, or lack of confidence in himself and his men. Perhaps he may be ill, or worried about domestic or financial matters.

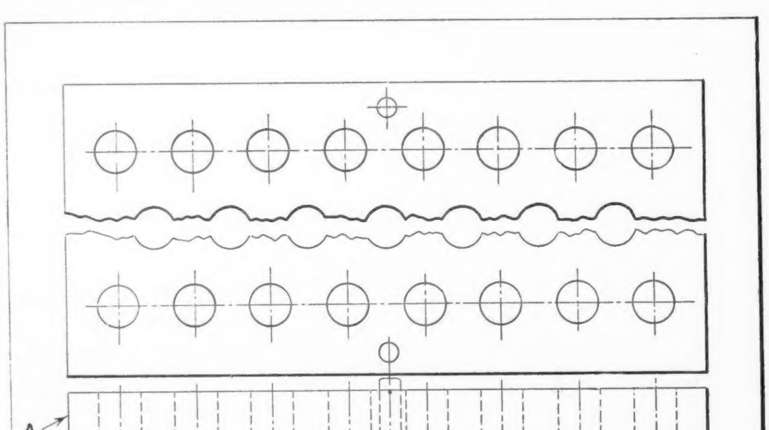


Fig. 3. Assembling Plates, Showing Honeycombed Construction

RECENT DEVELOPMENTS IN BEARINGS

Bearings of the "high-lead" bronze types, now marketed by several makers, seem destined to occupy an important place in machine shop equipment. Although not specifically recommended as an oilless bearing material, bearings of high lead content have run as such for long periods, either through necessity or neglect.

Mixtures of copper and lead up to equal parts of each metal, have been so controlled that they practically become alloys. These bearing metals are now offered to the trade in the form of cored bars and as castings. When the higher lead content bronze bushings are pressed into place, they must be bored or reamed, owing to the closing in that takes place as a result of the softness of the metal.

Bearing metals that will stand up under high temperatures when proper lubrication is lacking are also being placed on the market in increasing numbers. They are valuable for such work as open conveyor bearings and for shafts running in an atmosphere that is hot and dry. Graphite compositions give these bearings the necessary qualities for such work. It is of interest to note that the high-lead bronzes are successfully used where the temperature is up to, and even higher than, the melting point of lead. D. A. H.

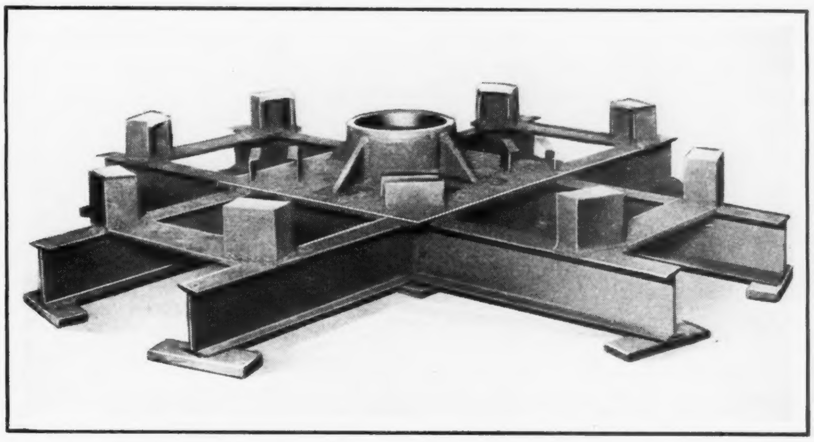
* * *

The method of training skilled labor in Belgium is frequently through an apprentice system arranged by a joint committee of operators and workmen. In the electrical industry, an apprentice receives the equivalent of \$0.035 an hour at the beginning of his training. After one year, this is increased to \$0.049, while at the end of the second year, his rate is \$0.063, and third year, \$0.068. The minimum rate for a skilled workman is \$0.146.

Notes and Comment on Engineering Topics

A compulsory automobile insurance law recently adopted in Sweden contains a clause to the effect that in case a car causing an accident cannot be found, the injured party can obtain damages from all insurance companies entitled to write automobile insurance, they being jointly liable.

The invention of a device that automatically records the effect of lightning strokes which do their damaging work in a few millionths of a second is credited to John F. Peters, consulting engineer of the Westinghouse Electric & Mfg. Co. This instrument is a very sensitive camera operated by clockwork that requires no attention for a full week, at the end of which time the film is replaced. It is now applied to many electric transmission lines in the United States for the purpose of indicating the magnitude, polarity, steepness, time of occurrence, and the direction of travel of the destructive bolt. The flash of the bolt is photographed on the film, which when developed, shows up these characteristics and is easily read by scientists to determine the effects of the bolt on the transmission line.



Vertical Water-wheel Generator Shaft Bearing Fabricated by Arc-welding

Hydrostatic tests of castings may be made before any machining operations have been performed, by the use of heavy rubber gaskets which seat themselves readily on the rough faces of the castings. A great saving may be effected in this way, as defective castings are discovered and thrown out before any machining work is done.

In addressing the Canadian Section of the Society of Automotive Engineers, Professor J. H. Parkin, who is in charge of aeronautic and research work in the faculty of applied science and engineering of the University of Toronto, reviewed the progress made in aviation during the last twenty years. He pointed out that the first crossing of the English Channel was made exactly twenty years ago this summer by Bleriot in a small monoplane provided with a three-cylinder 35-horsepower engine. In the same year, the first international aviation meet was held at Rheims, France, at which the following records were established: Speed, Curtiss, 47 miles per hour; altitude, Latham, 508.5 feet; and distance, Farman, 118 miles in 3 1/4 hours. Corresponding records today are 319.57 miles per hour, 38,800 feet, and 4417 miles.

An extremely interesting development has been announced by the General Electric Co. Sapphires, next to diamonds in hardness, are used at the rate of millions a year as jewels for bearings in meters and other delicate electrical instruments. Synthetic sapphires can be distinguished from the natural stones by means of the cathode ray tube. Trays of sapphires are exposed in a dark room to the rays of the tube for a few seconds. All glow or radiate colors while exposed to the rays, but when the rays are turned off, the natural stones cannot be seen, whereas the synthetic stones continue to glow. Not only is it possible by this means to sort natural from synthetic sapphires, but in most cases it is possible to determine the factory that made the synthetic stones by the different hue of the glow while the rays impinge upon them. Natural sapphires that come from different places can also be distinguished from one another.

Only seven years ago the journey from Bagdad to London consumed a full month. Now, with the invasion of the bus and automobile, the distance between these points is spanned in a week or ten days.

ARC-WELDED VERTICAL SHAFT BEARING

Vertical water-wheel generators require a low bearing bracket for the shaft. Bearing brackets of this type represent an interesting application of arc-welding. Such a structure is one of the more complicated applications, and is built completely of I-beams, rolled steel shapes, and plates. The vertical shaft bearing shown in the illustration was fabricated in the shops of the Westinghouse Electric & Mfg. Co. at East Pittsburgh, Pa.

Current Editorial Comment

In the Machine-building and Kindred Industries

RAPID PROGRESS IN METAL CUTTING

In November, 1928, an article was published in MACHINERY about "a remarkable new cutting alloy." Little was known then about the possibilities of this "cemented tungsten carbide," but during the past year it has been applied to a large variety of machining operations. Metals are being cut at astonishing speeds, and this new material has also proved capable of heavy roughing cuts. Steel has been turned at the rate of 600 feet per minute and cast iron at 1200 feet per minute. In other applications, long periods of use between successive grindings is the impressive feature. The cutting speeds just cited may not be either the maximum limits or the speeds that are practicable under all conditions, but they illustrate the great advancement in the art of metal cutting made within a single year. It is becoming increasingly difficult to predict future accomplishments in any direction, for many of the achievements of today exceed the most fanciful dreams of yesterday.

* * *

SHOULD FOREMEN DO CLERICAL WORK?

In many small- and medium-sized shops, the duties of the foremen are so diversified that it is difficult for them to find time to attend to their most important task of supervising the work in their departments. The foreman hires new men and puts them to work, instructing them about their jobs; he is timekeeper, inspector, clerk, and cost accountant; he orders materials and sets piece rates, and attends to other odds and ends about his department.

When the foreman is required to attend to all or many such duties, it is not possible for him to give full attention to his real job of supervising his department and of devising better and more efficient methods for doing the work. Much of the detail work could be handled by a clerk, and it is doubtful economy to save a clerk's wages by burdening the foreman with ordinary routine work when his time should be devoted to supervising and instructing his men and devising methods for reducing costs, increasing production, and improving the quality of the work passing through his department.

* * *

MODERN APPRENTICESHIP METHODS

An important problem is now being worked out in many industrial centers by reviving the apprenticeship idea and adapting it to the present needs of industry, providing future workers and executives for the machinery-building industry. It is recognized as a fundamental principle of all successful apprentice systems that the boy must be given a thorough training, and that his work must be regularly changed so that he may acquire a reasonably broad experience in his four apprentice years.

The wage scale also has an important bearing on the apprentice's interest, because an ambitious lad simply will not give his best for four consecutive years if he feels that he is being paid much less than others in the shop who are doing similar work. The plants that have been most successful in apprentice training are paying apprentices in accordance with a wage scale that is much higher than was customary under the old-time systems. In addition, to encourage unusually capable apprentices, many contracts now provide for the payment of bonuses in the form of increased hourly rates when the record of the apprentice warrants it. This plan has proved quite successful. It provides a definite basic wage rate, which is necessary in any apprenticeship system, and bases the compensation on the worker's ability and industry.

* * *

DEVELOPMENTS IN DIE-CASTING

Twenty years ago the die-casting process was in an experimental stage; it is now rapidly becoming a large and important industry. In many mechanisms and devices, die-castings now play an important part. Frequently the use of the die-casting process has made possible the development of designs that would have been too costly to produce by ordinary machining methods, the die-casting being complete when it comes from the mold except, perhaps, for a simple cleaning operation. Holes may be cast within limits of 0.0005 inch. Gear teeth, projecting studs, and cam surfaces can be produced without machining, and of late it has been found possible not only to produce very intricate die-castings, but parts of large dimensions as well. The use of die-castings effects a great saving in time and labor cost, in machine equipment, and in the expense for building jigs and fixtures and for tools of various kinds.

Recently alloys have been developed for the die-casting process which possess strength, ductility, and resistance to shock to such an extent that they approach mild steel in their characteristics; and means are constantly being found for casting metals that formerly were considered impossible to handle by this process. There is a great future for the die-casting process, and it is likely that the next few years will see still further developments that will open up new fields of application.

Group Wage Payment Increases Efficiency

Important Points Concerning a Wage System that Has Served as an Incentive to Employes to Increase their Output

By JAMES H. MARKS, The Packard Motor Car Co.

SEVEN years ago the group system of wage payment was tentatively established in one department of the Packard Motor Car Co., Detroit, Mich., with a view to finding an incentive for increasing the output and loyalty of shop employes. A bonus of 1 per cent of his earnings was offered to every employe in this department for each per cent that the efficiency of the department was raised within a certain pay period. In less than a month's time, the efficiency of the department had been increased as much as 50 per cent.

One of the important factors in increasing efficiency and promoting harmonious relations between labor and management in the plant of the Packard Motor Car Co. is the group wage payment system. After a trial of six years, this system has been found to increase the general efficiency 35 per cent and raise the wages of employes 15 per cent. It has thus proved to be highly satisfactory both to the management and to the men. The features of the system are such that the employes work not only fast, but carefully. Hence, the quality of the work does not suffer from the increased speed of output. Incompetent or unambitious workmen are automatically eliminated by the action of the men themselves. The system described should be well worth a careful study.

Because of the almost phenomenal success of the plan in this one department, it was decided to adopt the group system of wage payment for all productive labor in the entire plant. The immediate result was a general increase in efficiency of 35 per cent, which has been steadily maintained, with an increase in wages of 15 per cent in the form of a bonus. After six years of successful operation, the system is still most satisfactory both to the management and the men.

It is significant to note that the development of the group system of wage payment was started toward the close of a business depression in the automobile industry. Only the best operators had been retained, and it was natural to assume that the mere fact of a man having a job was enough of an incentive to make him put forth his best efforts. Most departments were therefore believed to be operating at a high degree of efficiency, and it was surprising to learn from time studies that their efficiency ranged from 35 to 60 per cent only.

Prior to that time, the company had been using the hourly rate, piece rate, and differential premium methods of wage payment, and at one time all three methods were in use. With the adoption of the group system, waste was greatly eliminated, as emphasized by the fact that the plant efficiency ever since has been approximately 85 per cent.

Bonuses Paid are in Direct Proportion to Increased Effort

Workmen in the Packard shop organization are divided, as normally, into manufacturing groups or departments. With the group payment system, it is not necessary to classify the men according to the same or similar kinds of work. An accurate time study of each operation was made, with a competent workman performing under normal conditions and without any allowance for lost time or inefficiency.

Time studies were also made to determine the necessary lost time for tool set-up, machine repairs, oiling of machines, and so on, which will be found in an automobile factory to vary from 20 to 30 per cent of the total operation time. Efficiencies of from 70 to 80 per cent can, therefore, be expected in such a plant without unusual effort. Upon the basis of these studies, a predetermined standard time was set for each operation and for every group as a whole.

The wages paid consist of an hourly rate plus a bonus for any efficiency above the predetermined standard. The hourly rate is the current wage for each class of labor, and the bonus offered is in direct proportion to the increased effort of the employes. In other words, if any group turns out 10 per cent more work than called for by the standard schedule, the men in that group receive a bonus of 10 per cent figured on their daily wage. Thus, if any man receiving $5 per day as a regular wage is employed in a group that has earned a bonus of 25 per cent on any given day, his pay for that day will be $6.25.

The Packard Motor Car Co. considers it advantageous to pay a bonus in direct proportion to the increased production, because the company gets this increased production with the same investment in plant and equipment and with the same general overhead. Even though it pays the same labor rate for the added effort, it has a distinct saving in the cost of the parts produced.

Only Work that Passes Inspection is Credited to a Group

All parts produced by each group are checked and counted by disinterested inspectors. Only good pieces are credited to the group and so labor expended on rejected or scrapped pieces is lost. This feature of the system leads the employes to be care-

ful as well as fast. The total number of parts finished each day by any group is expressed in standard time and credited to the group. On the other hand, the group is charged with the elapsed hours as shown by the time-clock cards. The ratio of the standard time to the number of elapsed hours is multiplied by 100 to obtain the group efficiency as expressed in percentage.

For example, suppose that a group of eighty men turned out, in a day of nine hours, a sufficient number of finished parts to have a total standard time value of 626 hours. The total number of elapsed hours would be 80 times 9 or 720 hours. The efficiency of the day would equal the quotient of 626 divided by 720, multiplied by 100, or 87 per cent.

The efficiency of each group for the preceding day is posted every afternoon by not later than four o'clock, and so the men can keep a close account of the money they earned from day to day.

The Group Payment System Promotes Teamwork

Probably the greatest advantage of the group method of paying wages is the teamwork engendered among the employes of the various groups, and this is promoted by the daily posting of group efficiencies. Each man is selected for his ability to do a particular job, but he is willing to reach out beyond that job whenever he can by so doing increase the efficiency of the group. There is nothing that gets results more easily and quickly than wholehearted teamwork among a group of people, whether it be playing a game or doing work.

On the other hand, incompetent and unambitious workmen are automatically eliminated from the groups without any action on the part of supervisors. When a newly employed man assigned to a given group does not put forth the necessary effort to maintain or increase the efficiency of that group, the other members make it so unpleasant for him that he either qualifies and does his share of the work or quits the job of his own accord.

In the same way, the method attracts a good class of labor, principally because the men in the various groups are anxious to have vacancies filled by competent workmen, and so they make it a point to find positions for friends whom they know will be an asset to their respective groups. The men themselves would much prefer to pick their own fellow-workers than to have the usual employment agencies of the organization bring in strangers and possibly incompetent workers.

Overhead and Fixed Charges Reduced

Overhead and fixed charges are materially reduced because of the increased production obtained with the same investment in plant and equipment. This is a very important feature of the system. Assuming that the average efficiency of a plant without an incentive for increasing the effort of employes is 65 per cent, if the efficiency can be increased to 90 per cent the output of the plant is increased approximately 40 per cent without any additional capital investment. This considerable added return on the original investment has made the group system of wage payment very attractive to the management. The system also lends itself to a simple production control and cost-keeping plan.

Lower Inspecting and Counting Costs

There is also a material saving in the cost of inspection and counting, because it is necessary to perform this double operation on finished work only. Usually departments or groups are so arranged as to complete certain parts or sub-assemblies. It is not necessary to keep records of the operations done by each workman, as is the case with the piece-work wage system, and the danger of dishonesty through collusion of inspectors and workmen is practically eliminated. It would be necessary for an inspector to connive with all the members of a group in order to have his dishonesty pay him any amount worth while.

The group method also has a tendency to reduce loss of work through spoilage and scrap, for the reason that any work done on imperfect parts is lost, since only good pieces are counted. It automatically makes the workmen more careful. Aside from personal considerations, they do not want to be responsible for spoiling the work of their fellows and for reducing the amount of bonus earned by them.

Production Readily Started on New Parts

Whenever any changes are made in the design of parts or production is to be started on new parts, the time study department determines standard times for the various new operations and work can then be started immediately. Seldom are all the operations of a group changed at one time, and so it is relatively easy to bring in some new work without affecting the efficiency of a group much one way or the other. Some of the estimated times will be too high and some too low, and they will counterbalance each other. It has been found that men work on new jobs with the same zest as on old, and so standard times are quickly established without friction and without interference with production.

How Labor Costs of Parts Are Determined

The total payroll of any group is proportioned to the parts produced in accordance with the work performed, in terms of standard hours. As an illustration, suppose that the total number of standard hours of work turned out by a group in one pay period is 10,000 and the payroll is $7000, then the cost of a standard hour of work is 70 cents. The labor cost of any part produced by that group can therefore be easily determined by multiplying the time required for producing it, by the cost of a standard hour.

A cost formula is easily worked out taking in the functions of standard time, efficiency, and average base rate, multiplied by a factor determined by the bonuses earned. These factors can be worked out in advance so that when group efficiencies are de-

termined by actual performance, costs can be quickly ascertained. This cost method is so effective and rapid that it is possible to know the costs throughout the entire plant within forty-eight hours after they have been established. The method is accurate because it distributes the entire payroll.

The Men Themselves Control Costs

The men themselves actually control costs. If there are too many men in any given group in proportion to the production, the efficiency will be reduced and the bonus lost. The men will then object and either take turns in laying themselves off or will insist upon the force being reduced so that the wages of the men kept at work can be maintained at the proper level. As production requirements increase or decrease, the management needs only watch the group efficiency in order to determine the number of men that should be employed. The number for any desired efficiency can easily be determined by multiplying the production required in standard time by the efficiency desired, and dividing by the elapsed hours.

Cost of Keeping Payroll Records is Low

With this group payment system, it costs little more to keep the payroll record than with the hourly rate method. There are approximately 13,000 men engaged in productive labor in the Packard plant, and only two more persons are required in the time office for computing the time and wages of these workmen than would be necessary if they were working on a straight hourly rate basis. The cost of computing the efficiency of all groups in the plant is 15 cents per $100 of direct labor, while the total cost of cost-finding and control, is 10 cents per $100 of direct labor. This makes a total cost-keeping expense between 25 and 30 cents per $100 of labor with the group method of wage payment. No timekeeper is required in any production department.

* * *

It is interesting to note the great progress that has been made in locomotive building in recent years. From 1911 to 1927 the average tractive power of the steam locomotives in use on American railroads has been increased from 28,300 pounds to 42,800 pounds, an increase of over 50 per cent. This increase in the size and power of locomotives has made it possible to handle 4 per cent greater passenger traffic and 72 per cent greater freight traffic, with but 6 per cent increase in the number of locomotives used. The total tractive power of all the engines in use in 1927, as compared with 1911, was increased by 60 per cent.

Design of Self-centering Devices

In some cases, the proper functioning of a machine depends on assembling certain parts in such a manner that they can be deflected or forced out of their normal positions by other elements of the machine. Usually such parts must be so designed that they will return automatically to their normal positions when the deflecting forces are removed. The design and use of a variety of pivoted levers and sliding rods provided with self-centering features will be described in January MACHINERY. This article provides valuable reference data for machine designers, and will be found of assistance in remedying faults in existing devices of this character.

SYSTEM AND EFFICIENCY

"Many concerns, especially the large ones," says Herbert N. Casson in *Forbes Magazine*, "have the delusion that system is efficiency. Certainly it is not. System means regularity. Often, it means getting in a rut. It may mean doing the wrong thing persistently. A company can go down into bankruptcy systematically. System and efficiency are like instinct and reason. Instinct means doing a thing always the same way, by means of a racial memory, while reason means thinking about what to do.

"At least once a year, every large enterprise should study its system and improve it. Otherwise it tends to become less and less efficient. The Civil Service is all system and no efficiency. System is necessary in order to lighten the burden of the men at the top, and to have work done without supervision. But every system needs to be kept up-to-date. Once a concern becomes efficient, its system will not do it any harm, because it will be changed to meet new conditions.

"System does not consider results. It has no regard for net profits. It has to do only with methods of work. Efficiency, on the other hand, means getting always a higher percentage of results. It measures every job by net profits. Every executive should always bear this fact in mind—that system is not efficiency."

It is well worth while to carefully consider the ideas expressed by Mr. Casson. Too often it has been thought that after a system has been installed there is nothing further to worry about and the thing can be left alone and will run itself.

* * *

KEEPING FORGING DIES WARM

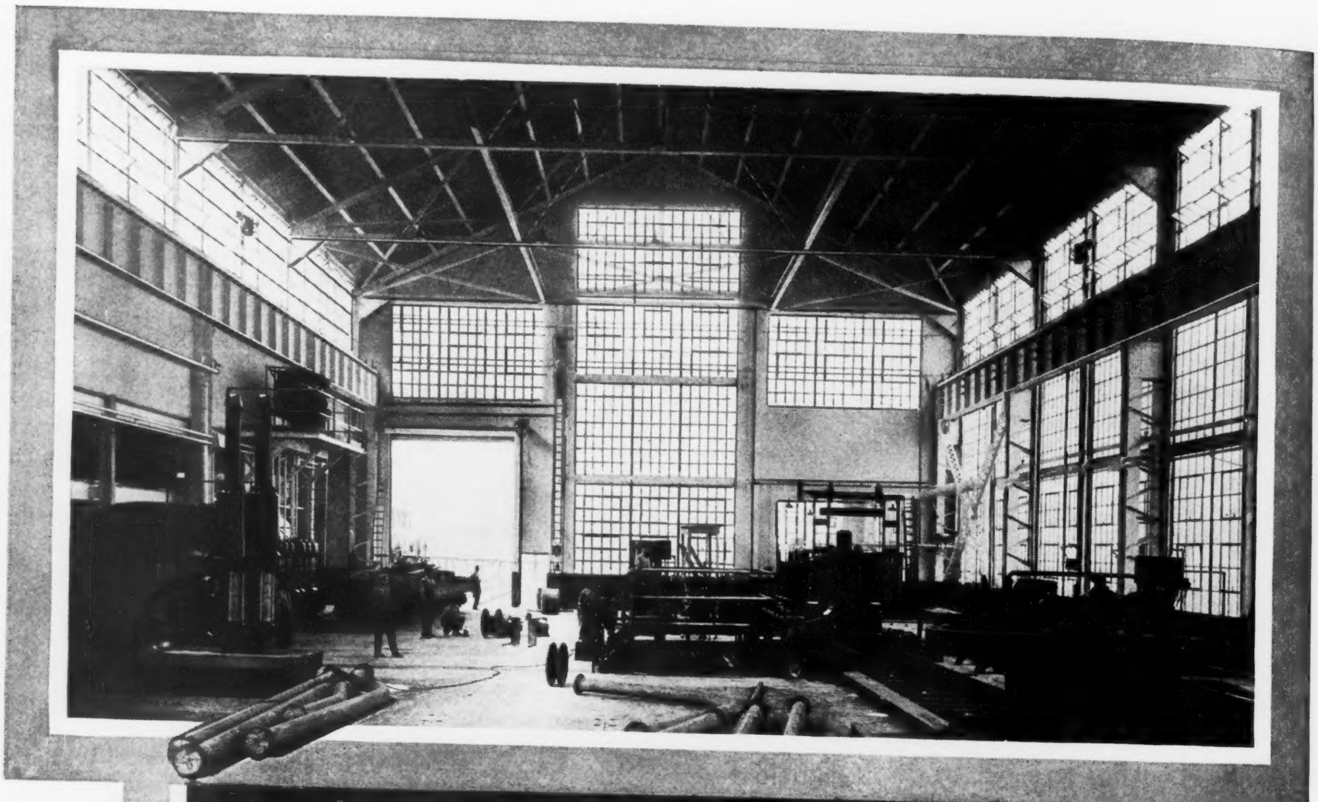
By JOHN HOMEWOOD

A forging shop located in Denver, Colo., where the nights are quite cool, found it necessary to warm up the forging dies each morning in order to eliminate the danger of breakage. As ordinary methods of applying heat to the dies required too much time, a box-shaped electrical heater was placed around the die and connected with the light socket at the close of the day's run. This arrangement maintained the temperature necessary to safeguard the dies.

* * *

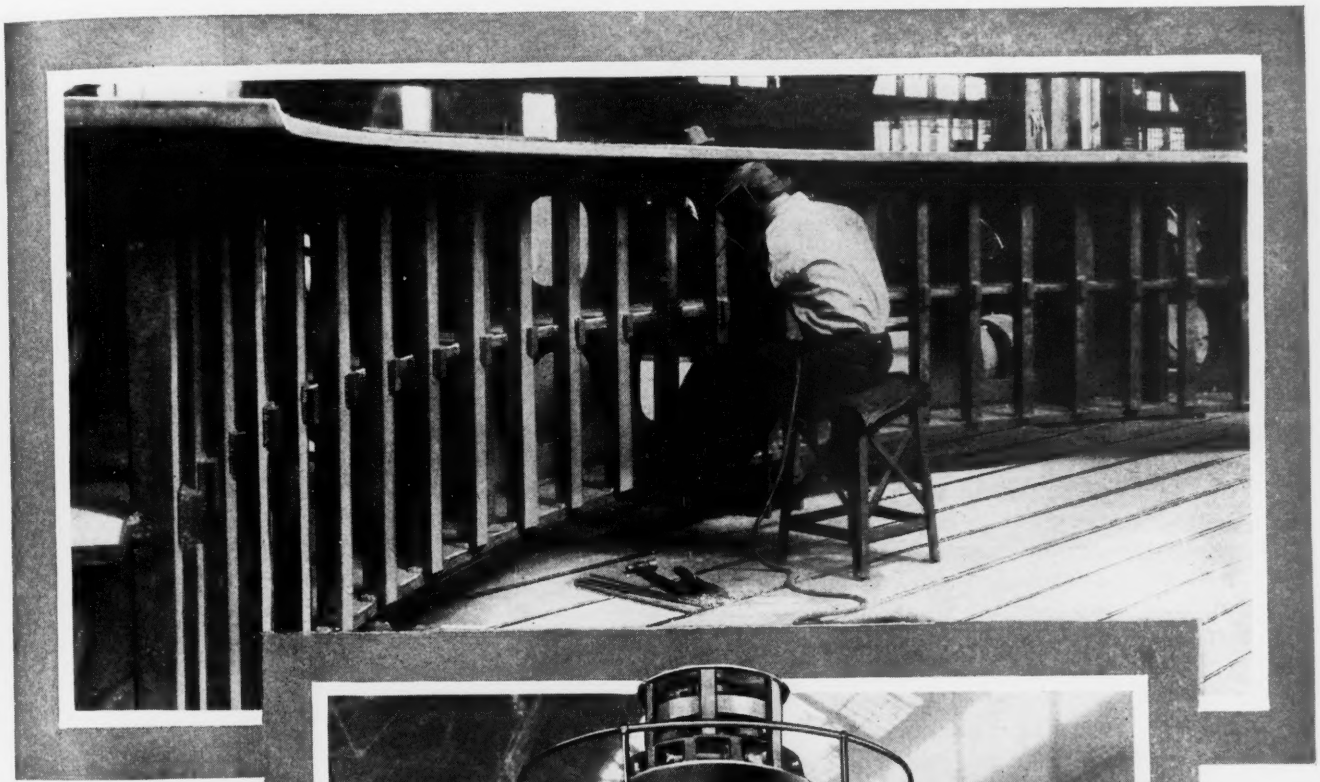
As a step in the elimination of unnecessary noise, it is stated that the licensing authorities of the metropolitan area of London, England, have issued an order that no new motor buses with solid tires will be licensed for operation in London after December 31.

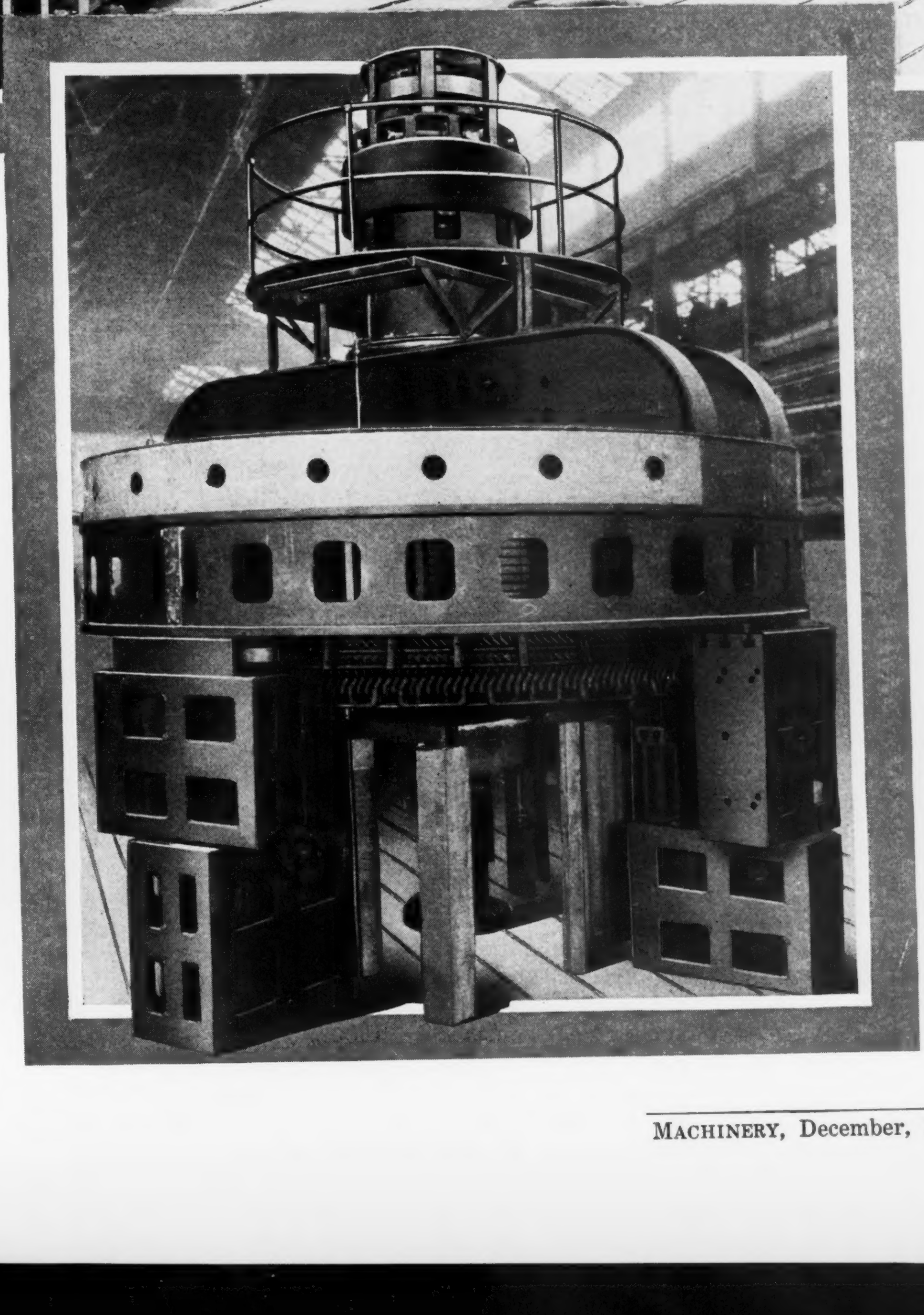
Recent Applications of Electric Welding



The new Westinghouse arc-welding shop at East Pittsburgh, Pa., is not only planned for the performance of arc-welding operations, but the building itself is of arc-welded construction. It is 75 feet wide, 170 feet long, and 40 feet high. A 15-ton overhead crane makes it possible to handle heavy pieces; roll and forming machines are installed for bending and shaping the various parts for welded machinery. The equipment arc-welded in this shop includes motor and generator frames, motor rims, and motor end bells. At the left is shown an all-welded turbo-generator stator.

Typical Examples in the Westinghouse Plant





The illustration above shows an interesting example of the application of welding in the construction of very large equipment. A section of a large water-wheel generator stator is shown as welded in the shops of the Westinghouse Electric & Mfg. Co. The stator has an outside diameter of 33 feet, and is assembled entirely by arc-welding. Another interesting example of huge machinery fabricated by the arc-welding method is shown at the right. All parts of this vertical water-wheel generator are made from arc-welded structural members. The generator is 6250 kilovolt-ammeters, 11,000 volts, 60 cycles.

What MACHINERY'S Readers Think

A Department for the Interchange of Ideas on Problems of Management, Foremanship, and Employe Relations

IMPORTING SHOP SUPERINTENDENTS

For detail work in the shop it is best to employ men who are thoroughly experienced in the particular line of work to be done. However, when it comes to a supervising position, such as that of shop superintendent, the man himself is the important factor. In that case, mere knowledge of details should not be the sole criterion. Importing a man who has had a broad and varied experience and has demonstrated his ability in another plant may prove more advantageous than promoting a man from the ranks.

Furthermore, every organization should at times be inspired with new ideas. A man who has had extensive experience in other plants naturally possesses a fund of knowledge which is not restricted to a particular shop. Fundamentals are of real significance to a superintendent, no matter to what product they may be applied.

Therefore, bringing in a new superintendent who has all the necessary qualifications except direct experience in the shop concerned, may be a real boon to the organization. The superintendent who is equipped chiefly with detail knowledge may be successful as long as conditions remain the same, and yet become almost worthless as changes and developments take place in shop practice. The possession of basic information and initiative are the real qualifications of a good superintendent.

HARRY KAUFMAN

"CLEAN-UP" DAY IN THE JOB SHOP

While job shops may have weekly and special "clean-ups" and certain times for returning all tools to the tool crib, many things accumulate that give such shops a cluttered appearance not found in production shops. Customers do not realize that this is due to the difference in working conditions. Many job shops lose contracts because of the untidiness of their plants and never suspect the real cause.

A practical way to help this situation is to have a general "clean-up" day on which to do the usual cleaning up, the checking up of tools, the cleaning up of the machines, and most important of all, the returning of raw material to the stock-room. It is customary for men in job shops to keep odds and ends of all sorts of special materials for future use. Consequently, each individual acquires a sort of miniature storeroom. Some men practice this more than others, and in many cases their stock of odds and ends serves as a kind of sample room from which the other men obtain a little piece of material before going to the stock-room for a full order.

Much of the work done in job shops, being of an experimental nature, is abandoned or scrapped before completion. These abandoned jobs, often representing a great deal of work, are invariably valueless, yet they are stored away with the hope that some of the parts may be used on another job. Then there are also the samples, models, special tools, etc., that are carefully stored away and generally forgotten.

To set aside a special day for cleaning up all this accumulation may seem very expensive in terms of lost production time, but it has been demonstrated that the results more than offset the cost. The return of all the various items to a salvage department where they can either be scrapped or put to some good use may constitute a big saving, but of greater importance is the improved appearance of the shop, which will be a factor in helping to obtain new business.

JOHN W. GARDINER

A COMMON FALLACY IN PLANT ECONOMICS

Concerns in the market for single-purpose machines often feel that the prices asked are too high and frequently decide that they will build the machines themselves, believing that they will thus save considerable money. They do not realize that because of inexperience in manufacturing machine tools, difficult problems are likely to arise which can be solved only at an expense far greater than the price quoted. In the construction of single-purpose machines, there usually lurk "bugs" which must be "licked" before the machines will function properly. Shops quoting on special machines generally have had to solve such problems and are justified in charging prices commensurate with their knowledge.

Some time ago a manufacturer wanting a special machine for producing an accessory asked a quotation from a company that has been building machines of that type for many years. A price of $17,000 was quoted, which the prospective customer protested was far too high; he decided to build the machine himself. Unforeseen difficulties arose in carrying out this plan, and in the end the machine cost the company $30,000. Furthermore, it has never operated satisfactorily, because one simple principle was overlooked in its design. The machine is almost a direct copy of those built by the concern that made the quotation, and so, in addition to his other troubles, the builder of the unsatisfactory machine stands the chance of being sued for infringement of patents.

OLIVER HERBERT

Gaging Small Interchangeable Work

Developing and Applying a Gaging System Intended for Use in the Manufacture of Low-priced Clocks and Watches

By L. E. KING

ALTHOUGH this article deals with gages and gaging methods that were developed especially for use in the interchangeable manufacture of alarm clocks and low-priced watches, the information it contains is applicable to small parts of a class used in a great variety of small mechanisms. A brief outline of the conditions under which the system was developed will be given first, so that the difficulties encountered and overcome will be readily understood.

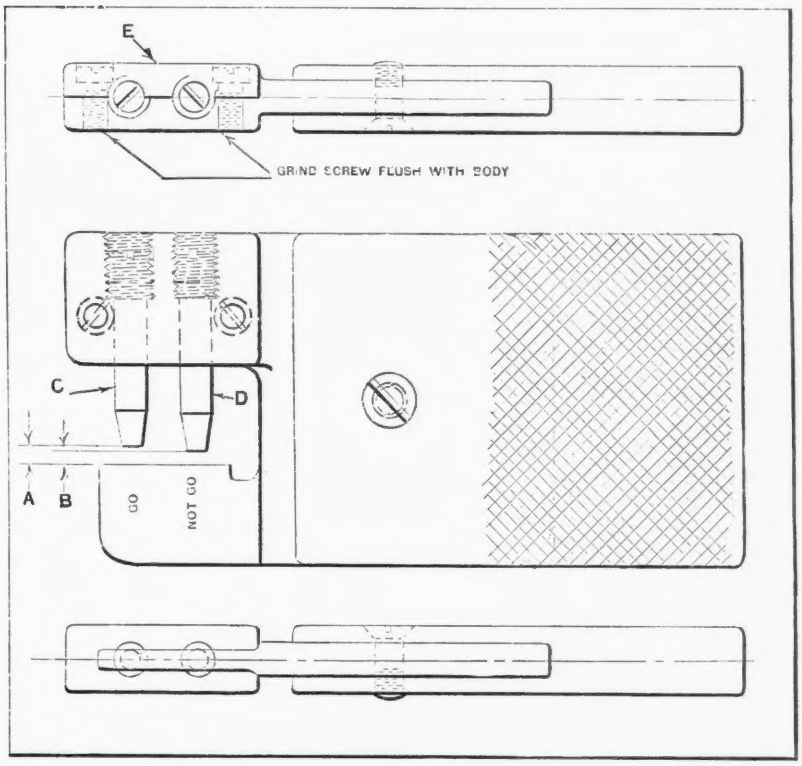


Fig. 1. Snap Gage with Adjustable "Go" and "Not Go" Anvils

In the manufacture of mechanical products, it is generally recognized that the next step after perfecting the design is to make working drawings. In the case under consideration, no adequate working drawings were in existence. Although drawings of a kind had been made, they were of no value except as a general guide, for they had been made from the parts themselves without paying attention to the dimensional coordination of mating parts.

With due respect for the skill and ability of the maker of the original models, it must be stated that the designs had never been developed to the point where they were really adapted for interchangeable manufacture. In a few words the product had not been "engineered." Notwithstanding this disadvantage and the lack of adequate gage equipment, the company was doing a fairly large and successful business. Competition naturally has confined companies doing business in this manner to the manufacture of products that are seldom if ever repaired and to products that are used only once, such as containers.

Under such conditions, it was impracticable to make working drawings, as they would not be used in the factory for either manufacturing or toolmaking purposes. It was therefore necessary to produce the gages without the aid of drawings other than dimensioned sketches of the parts, which, of course, could later be reduced to working drawings. It was necessary to make extensive measurements of existing parts in making the required sketches on which the tolerances were set. This may appear to be a tedious and expensive process, but the conditions described, and the lack of cooperation from the manufacturing department made this procedure necessary.

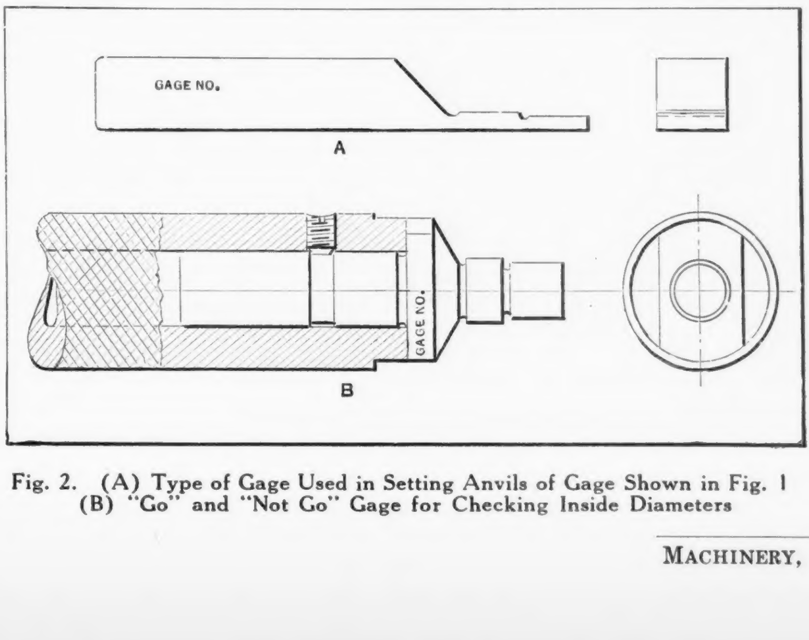


Fig. 2. (A) Type of Gage Used in Setting Anvils of Gage Shown in Fig. 1 (B) "Go" and "Not Go" Gage for Checking Inside Diameters

Setting Manufacturing Tolerances

In setting tolerances, a considerable number of factors must usually be taken into account. Some of these may be classified as follows:

1. A part must function properly

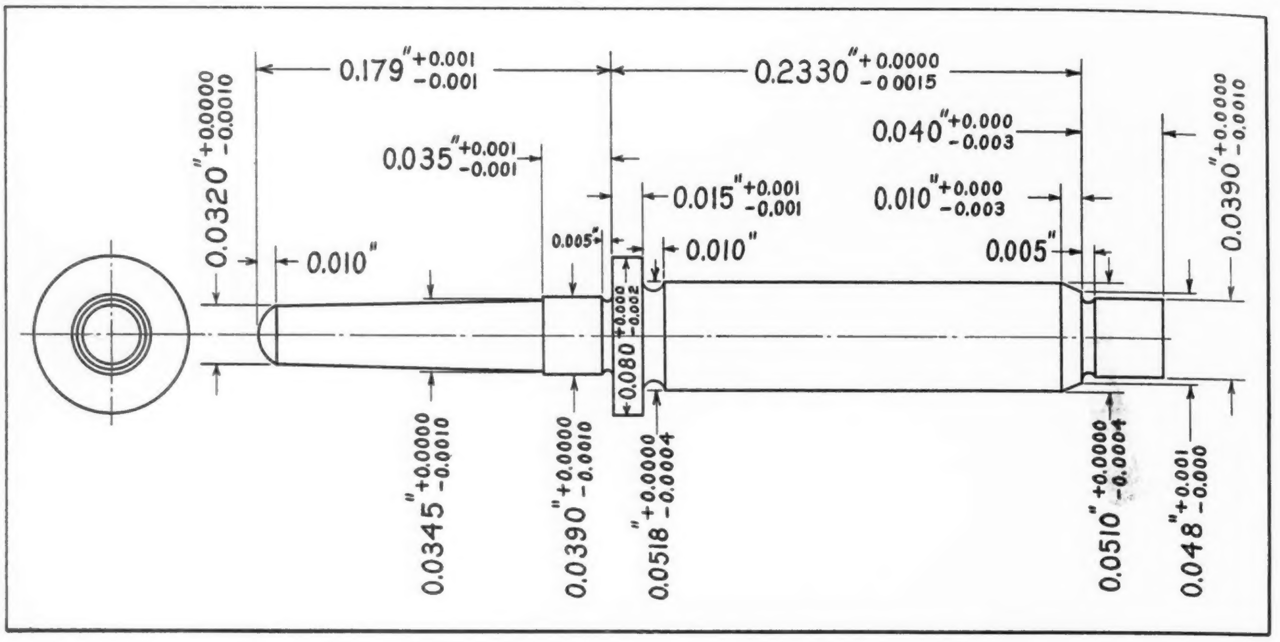


Fig. 3. Typical Screw Machine Product Requiring Special Inspection Gages

with its mating part or parts and must require the least possible attention in assembling.

2. The effect a change in any dimension of a part will have on the functioning of the mating part or parts must be considered.

3. The possible degree of accuracy, considering the operations performed on the part, the available equipment, skill of the workmen employed, etc., should be determined.

4. The limits or tolerances should be as wide as is consistent with the requirements stated in Rule 1.

From the foregoing it will be apparent that the setting of tolerances must be a matter of good judgment aided by the best data that can be obtained on what is being done and on what can be done with the equipment that is available.

Measuring Parts and Setting Tolerances

In measuring parts preparatory to the setting of manufacturing tolerances in the making of inspection and working gages, it is necessary to have instruments of precision for determining lengths and angles. These measurements must be made with a precision far greater than can be maintained on the work. The precision instruments should be able, within their range, to give the same results any number of times when used by the same or different operators, and should preferably be so designed that they can be applied directly to the part, so that errors resulting from the transfer of measurements will be avoided.

Generally, the measuring equipment may be divided into two classes as follows: (A) Precision instruments which preferably may be used with a reasonable degree of rapidity; (B) less precise and simpler instruments which may be used for rough checking and which, in many cases, may be used later for inspection purposes.

In accordance with these requirements, the following instruments and apparatus were secured: (1) Two sets of gage-blocks having a fairly complete range by increments of 0.0001 inch from 0.010 inch up to 4 inches; (2) one fluid gage having a multiplication ratio of 1500 to 1; (3) one fluid gage having a multiplication ratio of about 2500 to 1; (4) one optical projection apparatus with a work-holder having horizontal and vertical micrometer screw adjustments and an angle measuring device, together with various special attachments for holding different

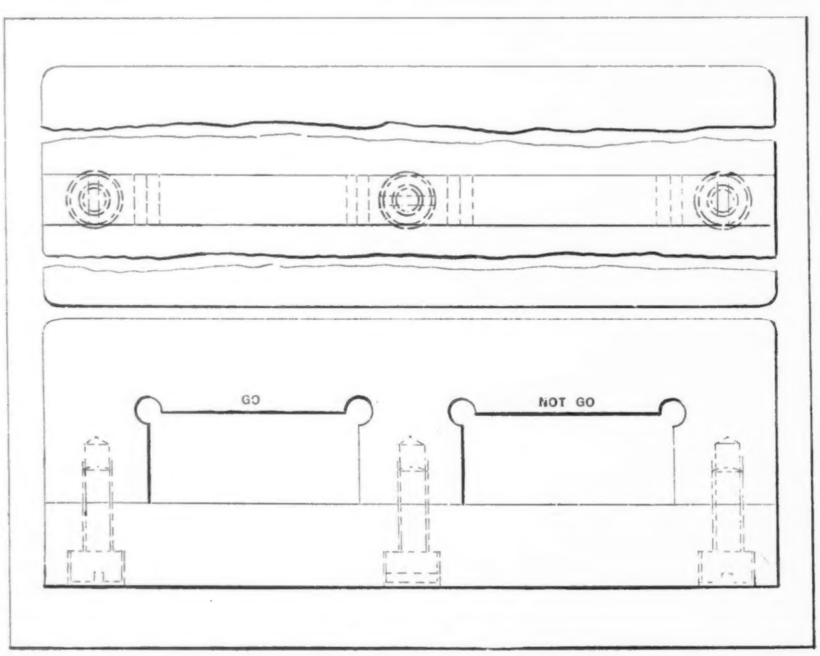


Fig. 4. Length Gage of the Push-through Type

kinds of parts (This apparatus was set up and adjusted for a magnification of 75 to 1. By the use of carefully made charts, readings could be made, in most instances, at least as close as 0.0002 inch.); (5) one microscope with a "filar" or hair-line micrometer eye-piece; (6) several types and sizes of micrometers, depth gages, and vernier calipers; also dial gages, as well as accessories such as a bench-plate, universal right-angle iron, etc.

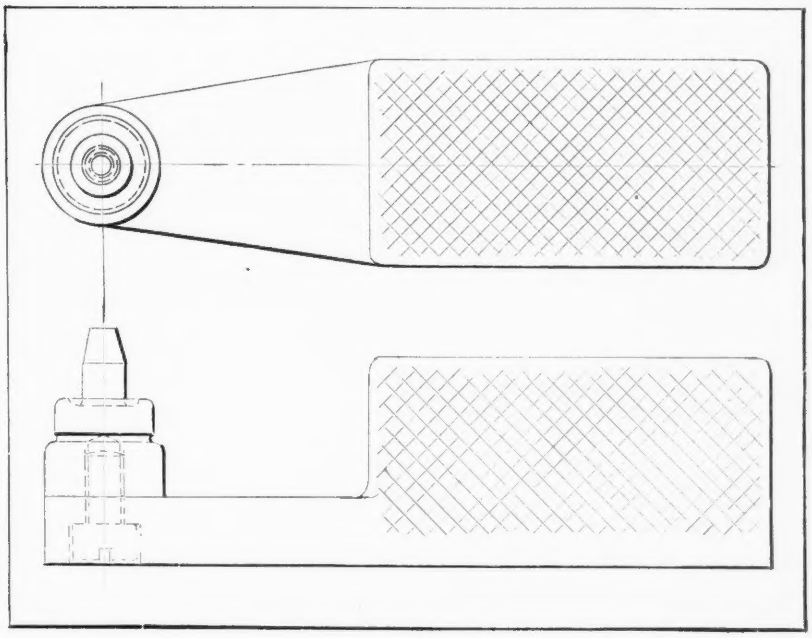


Fig. 5. Type of Work-holder Used in Conjunction with Push-through Gage Shown in Fig. 4

Gages Required for Screw Machine Work

For screw machine operations, gages were required for inspecting diameters, both outside and inside, as well as lengths and depths. For outside diameters, some form of snap gage of either the fixed or adjustable type was used. As the gages on the market were too large for this class of work, a special design was made, as shown in Fig. 1. These gages are 2 5/8 by 1 1/4 by 1/4 inch in size, including the handle.

The gage pins *C* and *D* are 0.125 inch in diameter and taper to a diameter of 0.070 inch at the gaging end. The holes for these pins are reamed with a 0.010-inch spacer between the clamping plate *E* and the body of the gage, while the holes for the adjusting screws are tapped without the spacer. This method of making the gages permits adjustable pins to be used, and provides for holding them securely in place by

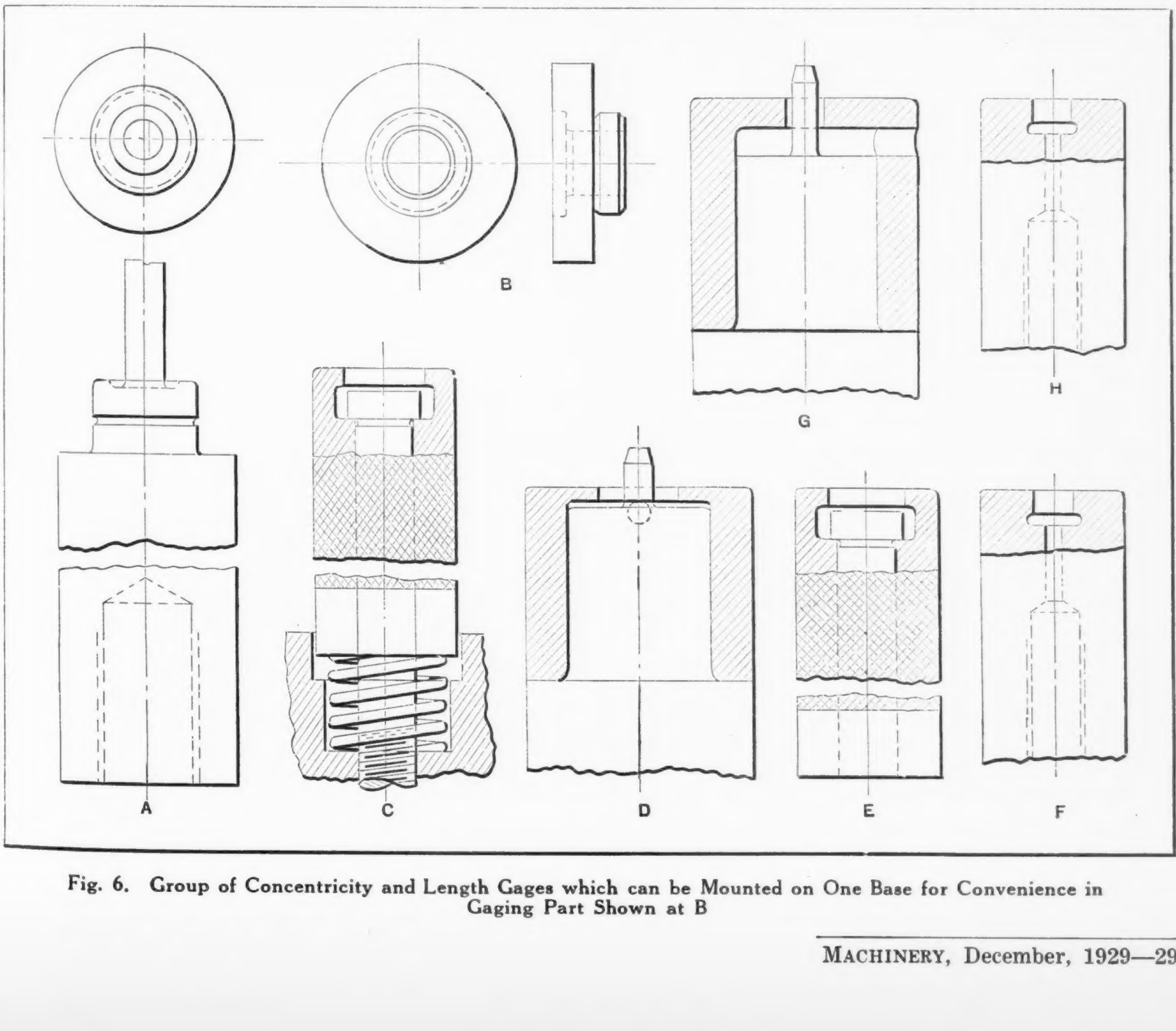


Fig. 6. Group of Concentricity and Length Gages which can be Mounted on One Base for Convenience in Gaging Part Shown at B

tightening the screws that hold the clamping plate E in position on the body of the gage. After a gage of this type is properly adjusted, the clamping and adjusting screws are sealed.

A set of checking gages like the one shown at A, Fig. 2, is provided for each dimension of a part for which gages of the type shown in Fig. 1 are used. Such a set of gages consists of a master, an inspection, and a working gage. The master checking gage is used only for checking the wear on the inspection gage, the inspection checking gage is used for setting the inspection gage and checking the wear on the working gage, and the working gage check is used for setting the gages used in the shop. In Fig. 3 is shown a typical screw machine product for which gages like that in Fig. 1 are suitable.

For gaging inside diameters, double-end gages such as shown at B, Fig. 2, are generally employed. A considerable number of these gages are used, particularly for checking small drilled holes. This type of gage is of special importance, as it is used for holes whose size depends on the accuracy with which the drills are sharpened, an operation for which no drill grinder was available in the shop. The size of these drills falls within the range of from 0.025 inch to 0.125 inch. The working limits on holes produced with these drills can rarely exceed 0.001 inch.

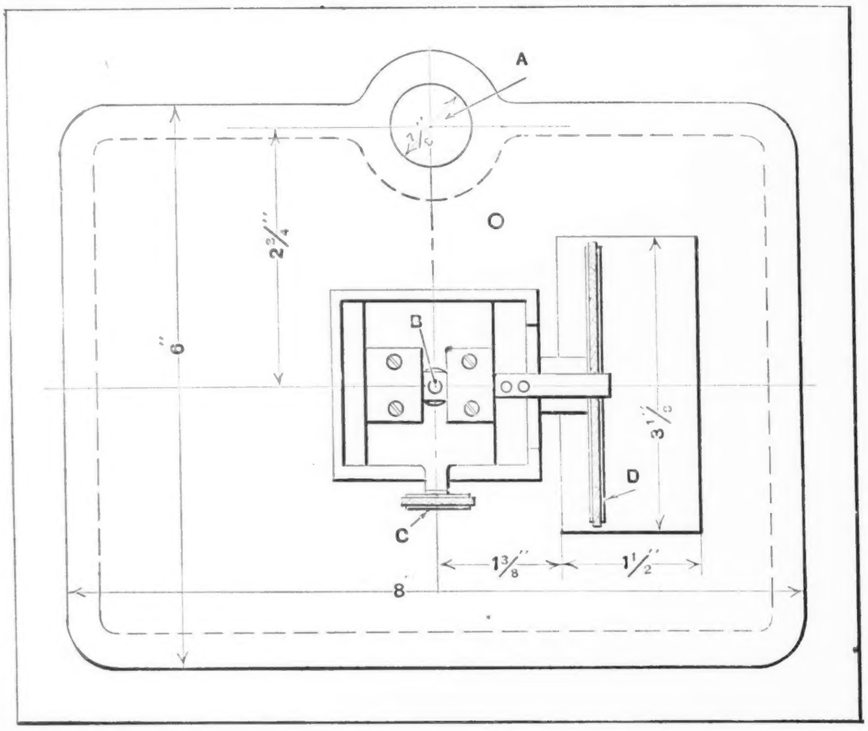


Fig. 7. Plan View of Base and Holder for Fluid Gage for Hair-spring Wire

Fig. 8. Front and Side Views of Holder Shown in Fig. 7

At A, Fig. 6, is shown a length gage for a counterbored part similar to that shown at B; this gage can be used in cases where great accuracy is not required. The gage A is arranged to be mounted on a base in conjunction with other gages employed in checking the same part. This arrangement was adopted for most of the smaller parts, as they could be more readily placed on or in the gages than the gages could be tried in or on the parts.

Push-through and Concentricity Gages

In Fig. 4 is shown a length gage of the push-through type. Occasionally, counterbored parts similar to the one shown at B, Fig. 6, are inspected by this type of gage, used in a holder such as shown in Fig. 5, when the distance from the bottom of the counterbore to an outside shoulder or end is of foremost importance.

The gages D and G, Fig. 6, are concentricity gages for gaging the part shown at B, gage D being used for the large diameter and G for the small diameter, while gages C and E are the "Go" and "Not Go" gages for the large end, and gages F and H the "Go" and "Not Go" gages for the small end. For convenience, these gages are all mounted on one base. The concentricity gages G and D are each composed of two hardened parts, shrink-fitted together. The minimum diameter of the parts thus fitted was 5/16 inch, and the allowance for the shrink fit was 0.0001 inch minimum and 0.0003 inch maximum, which permitted the necessary expansion and contraction to be produced by the use of hot and cold water. This method of assembling does not affect the temper of the part or cause undue stress which might cause the shell to split.

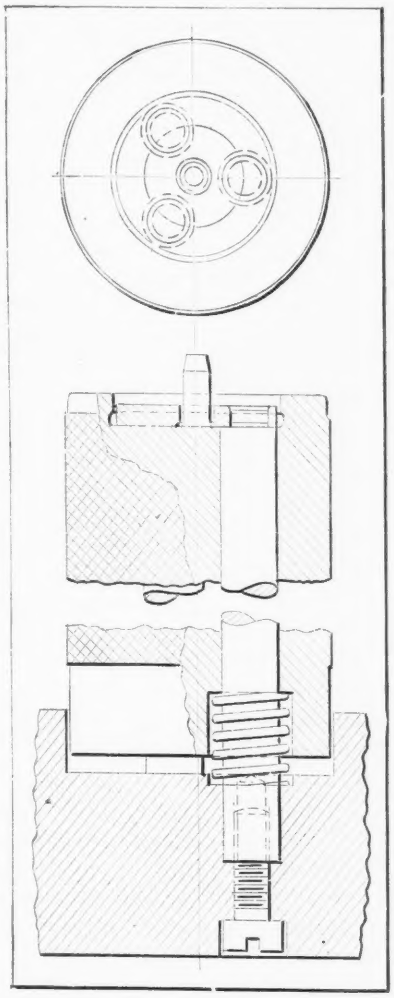


Fig. 9. Concentricity Gage for Punched Gears

The "Go" and "Not Go" gages C and E are mounted on springs, so that the part can be readily ejected from the gage. For the contours of flat punched parts, limit line-charts are used in connection with the optical projection apparatus. This apparatus is adjusted for a magnification of 75 to 1, and the limit of accuracy in most instances is 0.0002 inch. Such apparatus is particularly well adapted for checking the teeth of gears and escapement wheels.

The concentricity gage shown in Fig. 9 is employed for gaging punched gears, and is provided with ejecting plungers.

Fluid Gage for Hair-spring Wire

In Figs. 7 and 8 are shown, respectively, plan and front and side views of a base and holder used in conjunction with a fluid gage for measuring either continuously or intermittently the thickness of hair-spring wire. As a change of even 0.0001 inch in the thickness of hair-spring wire 0.004 inch thick causes a variation of about 5 per cent in the force of the spring, it is apparent that the thickness must be accurately controlled.

The shaft of the fluid gage is held in the round opening A, Fig. 7. The fluid gage, not shown, has a magnification of about 2500 to 1 and is provided with an exceptionally thin diaphragm. A thin diaphragm that exerts very little pressure is necessary in this case, as only a light tension can be placed on the thin wire when it is drawn between the gaging anvils. The anvil attached to the center of the diaphragm consists of a sapphire jewel having a spherical contact surface. In the lower anvil of the gage there is a jewel B, Figs. 7 and 8, which has a cylindrical surface.

By means of the adjusting screws C and D, the jewel in the lower holder can be brought into accurate alignment with the jewel attached to the diaphragm of the fluid gage. Adjustable guides are provided for the wire, so that its thickness can be tested at any point. Thus, any variation in thickness throughout the width of the wire can be detected by merely shifting the position of the wire along the cylindrical surface of the lower jewel.

As hair-spring wire is thinner than the thinnest gage-blocks obtainable, it is impossible to set the gage by the direct application of standard blocks. By determining the amount that the lower jewel projected above the ground and lapped surface of the block in which it was mounted, it was possible to use a gage-block of the proper thickness in setting the diaphragm jewel to the proper position for zero height. With this type of gage, a variation in thickness of 0.00001 inch could be readily detected.

* * *

To insure a tight uniform fit of bushings in connecting-rods in the Packard plant, a mechanical device attached to an air-operated press is used. The pressure exerted is measured on a pressure gage; stops on the face of this gage are connected with two electric circuits, one of which lights a white lamp and the other a red lamp. If insufficient pressure is used to seat the bushing, the red light flashes, indicating that the fit is not tight enough. On the other hand, when sufficient pressure is exerted to force the bushing in, the white light flashes, indicating a tight fit.

Making Cemented Tungsten-Carbide Tools

How Cemented Tungsten Carbide is Produced, and Recent Information About the Grinding and Lapping of These Tools and Their Applications to Different Classes of Machining Operations

METAL-CUTTING tools made of cemented tungsten carbide have aroused an unusual degree of interest throughout the machine-building industry because of the exceptionally high cutting speeds that are possible with these tools, and also on account of their durability and adaptability in machining either very hard materials or compositions that are destructive to other tools because of their abrading actions. Many inquiries have been received from MACHINERY'S readers not only about the results that are possible with these tools, but also concerning the nature of cemented tungsten carbide—just what it is, how produced, and why the term "cemented" is applied. Information regarding these points will be found in the following abstract of a paper on "Tungsten-Carbide Tools," which was presented by Dr. Samuel L. Hoyt of the General Electric Co., at the semi-annual meeting of the American Gear Manufacturers' Association.

Some inquiries concerning this material, relate to the comparatively recent use of tungsten carbide for metal cutting, in view of the fact that this material has long been known. The explanation is that the pure carbide is weak, in any known condition, and the usual methods of melting and casting tungsten carbide have always produced a porous, coarse-grained material. It was by using the methods devised by Baumhauer and Schroeter, of the Osram Lamp Co., Berlin, that tungsten carbide was first made both tough and strong without sacrificing too much of its inherent hardness. This method will be briefly discussed.

General Manufacturing Process

The material used is tungsten metal powder, similar to the powder used in the manufacture of lamp filaments and other pure tungsten products. It is quite pure and extremely fine grained. This pure tungsten is converted into tungsten carbide (WC) by mixing the metal with the required amount of carbon and heating the mixture in an electric furnace to about 1500 degrees C. for several hours. When properly carried out, this treatment produces a pure tungsten carbide which is but little coarser than the tungsten metal powder. Pure cobalt metal powder is also made by the reduction of pure cobalt oxide. The cobalt metal powder is mixed with the tungsten carbide powder to secure a thorough and uniform mixture, whereupon the mixed powders are ready to be made into tools.

The first step is that of pressing bars or briquets in a hydraulic press in a steel mold. The entire bar is then heated to a red heat to harden it sufficiently for handling. In this condition, tungsten carbide can be cut up into smaller bars or shaped approximately to the shape of the finished tool. However, in doing this, the shrinkage that accompanies the final sintering must be allowed for. The final operation is that of heating the parts to a temperature of about 1400 degrees C., which converts them into a permanently hard condition. This operation is one of sintering, and the result is that the fine particles of tungsten carbide become cemented firmly together by the cobalt. This product is "cemented tungsten carbide" and is sometimes referred to simply as "tungsten carbide." It contrasts with cast tungsten carbide in that it is extremely fine grained and contains a strong tough matrix.

While the function of the cobalt is to cement the particles of tungsten carbide together, it is also true that the amount of cobalt used affects the hardness and strength of the mixture. Thus greatest hardness and least strength are obtained with a small amount of cobalt (about 5 per cent), while much greater strength and toughness and somewhat lower hardness are secured with a larger amount of cobalt (about 15 per cent). This is what would be expected from a variation of the relative amounts of a soft, strong constituent, and a hard, brittle constituent. Cobalt contents of 20 per cent and higher have been found to produce material that is too soft for use as a cutting tool.

Applying Tips of Cemented Tungsten Carbide to Steel Shanks

The most common method of preparing tungsten carbide in tool form is by copper-brazing a tip to the end of a steel shank. For this method, the shank is first milled out to receive the tip, and here a fairly good fit is desirable, for the better the fit, the better and stronger the joint. The brazing is done in an electric furnace in an atmosphere of hydrogen, according to the usual method.

Later it was found that the carbide tip may be fastened on by welding the tip and shank around the contact between the two. The shank is first beveled off at the margin and the space left filled in with a welding rod, using the atomic hydrogen flame. This method is particularly well adapted for use in a shop.

For the convenience of those desiring to read one or more of the articles previously published in MACHINERY on this subject, the following list is included: "Carboloy, a Remarkable New Cutting Alloy," November, 1928, page 214; "What May Be Expected from Carboloy," January, 1929, page 353; "Carboloy and Tungsten-Carbide Tools," February, 1929, page 457; "The Grinding of Tungsten-Carbide Tools," March, 1929, page 536; "How Carboloy will Affect Tool Design," April, 1929, page 613; "Tungsten-Carbide Tools for Production Work," April, 1929, page 621; "Widia, a Tungsten-Carbide Cutting Metal," May, 1929, page 692; "Latest Results from Tungsten-Carbide Tools," June, 1929, page 783; "A User Tests Tungsten-Carbide Tools," August, 1929, page 934; "Directions for Grinding Carboloy Tools," November, 1929, page 195.

Tools have also been made by uniting the tip and shank by the special cements made for holding high-speed steel tips to a steel shank. It has been found that tungsten-carbide tips which are rigidly welded to the shank are likely to come off the shank, either directly after the tool is made or after it has been put in service. This is due to thermal stresses set up by temperature changes and differences in the coefficients of expansion of the carbide and the steel. This circumstance accounts for the popularity of copper brazing, because here the thin layer of copper affords a soft cushion which absorbs such stresses without transmitting them to the carbide tip. On the other hand, copper softens at elevated temperatures, so that it is necessary, in the design of the tool, to remove the joint far enough from the cutting edge so that it will not become dangerously hot during operation. The "welded" tool loses less strength at high temperatures, and hence can be made smaller for a given job.

Grinding and Lapping the Tools

Wheels of the aluminum oxide type are too soft for effective grinding of tungsten carbide, so that silicon carbide wheels are used. Coarse grinding is done on a wheel of Grade 60, while fine grinding is done on wheels of Grade 100 to 120, or even 200. The hardness of the wheel and the binder used are important factors in the operation. The pressure on the wheel should be light, and grinding should be away from the cutting edge to avoid chipping.

Coarse grinding followed by fine grinding makes the tool satisfactory for ordinary operations. If the tool is to be used for fine finishing work, and if it must be made to a very close tolerance, the edge is frequently lapped with boron carbide or diamond dust to a smooth finish. By this means, the tool can be given a very good edge, and, if necessary, be brought to correct size within close limits. The lapped edge has been found to have a considerably longer life than the edge produced by grinding. The boron carbide powder used for lapping ranges from 140 to 200 mesh. This works fast at first and, as the powder becomes finer, produces a reasonably fine finish at the end.

The Rake and Clearance Angles

The clearance angles of the tool and the shape of the cutting contour best suited to tungsten-carbide tools differ from those used with high-speed steel. The cutting edge is given the maximum support commensurate with the cutting requirements of the material being machined, while the stresses imposed by the chip are transmitted to the shank.

As to the actual angles and shapes recommended, the specific application should be considered in all cases. In general, the top side rake of a simple turning tool for steel is made 12 to 14 degrees, or 4 to 6 degrees less than is common with high-speed steel. The front and side clearance angles are made from 3 to 6 degrees. If the tool is always set at center, or below, the smaller angle can be used to give greater support. Perhaps the most unusual feature is the 0 degree or even negative back rake which is so common. Another feature is the radius ground on the upper surface, which curls the chip and increases the life of the tool. The body angle of the cutting edge is increased as the strength of the steel being machined increases.

The cutting angles for cast iron are not greatly different, for general purposes, from those used for steel. Non-ferrous metals require different angles. It is customary to grind the tool with more of a "hook" by increasing the side rake and by adding a back rake which may be as great as 14 degrees. The number of individual applications involving many different machining operations and materials to be machined makes it impossible to discuss this subject in detail.

Application to "Automatics"

The outstanding characteristic of cemented tungsten carbide is its abnormally high cutting efficiency. This cutting efficiency can be utilized in machine shop practice in three ways—to secure greater tool life with about the same speeds, feeds, etc.; to secure higher cutting speeds; or to machine materials that have been classed as non-machineable. A good example of what can be accomplished along the first line is furnished by automatic screw machine work. Here the feeds are light and the speeds are high, while the time involved in setting up the various tools to obtain the accuracy required in this work becomes an important factor in the cost of doing the operation.

At Schenectady, one of the most successful applications of tungsten-carbide alloy tools is in the general automatic machine department. In this department automatic machines of practically every reputable make and size are used to produce parts that vary greatly in material, size, shape, and accuracy. The successful application of tools in this department consists not in the individual performance of a single tool, but rather in a series of multiple tool set-ups where parts are being produced very rapidly on automatic machinery. It makes little or no difference as to the nature of the material being machined in so far as savings in machine costs are concerned. It invariably follows that the operating machine hours are appreciably increased without any definite increase in schedule for feed, speed, and cut, due to the greater tool life between grinds. This shortening of idle machine tool time is a tremendous factor in the ultimate cost of automatic machine operation.

Cutting Hard Materials

A piston alloy was developed several years ago by research metallurgists of the Aluminum Company of America, and was known to possess valuable properties for this service, one, in particular, being its low coefficient of expansion. The high silicon content rendered this alloy "non-machineable" with the tool materials available at the time. With the advent of the cemented tungsten-carbide tools, it became possible to machine these pistons commercially. The Reo Motor Car Co. is now

using this aluminum alloy "Lo-Ex" for pistons. This example is mentioned to illustrate how a tool material is able to make an otherwise non-machineable material available to industry.

The material "Mycalox" is another example. This compound of mica and glass is the best known insulator for certain purposes, particularly in the radio field, but its great abrasive character made it non-machineable. At present large amounts are consumed and carbide tools are used to machine it.

Not long ago such operations could justifiably be classed as "stunts." These two examples and others that might be cited, show that the evolution of a stunt performance into an industrial operation may simply depend on the cutting efficiency of a tool material.

Machining Cast Iron at 1200 Feet per Minute

The effect of cemented tungsten carbide on machine tool construction is an acute question. In December, 1928, in a discussion written for the Machine Shop Practice Division of the American Society of Mechanical Engineers, the author of this paper pointed out some of the directions in which developments seemed likely to occur. In particular, it seemed at that time that higher speeds of machining were to be expected, on the basis that the superior cutting efficiency of the carbide tools would be more profitably utilized in that way, even though the tool life were materially shortened.

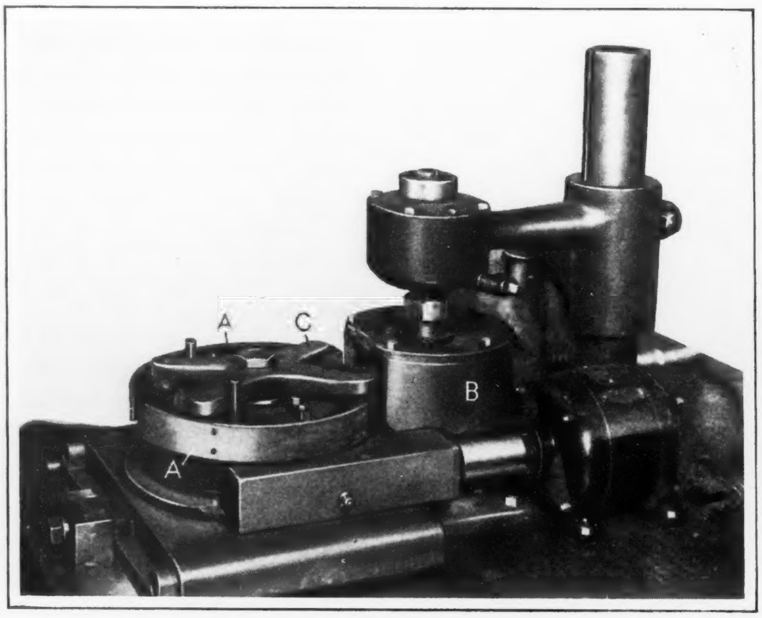
Concrete answers to this question were hardly to be expected so soon, but at least two of the leading machine tool builders demonstrated "carbide" lathes at the recent shows of the American Society for Steel Treating and the National Machine Tool Builders Association. These machines were specially constructed to take advantage of the cutting efficiency of cemented tungsten carbide. Cast iron was machined at a speed of 1200 feet per minute and steel at 600 feet per minute, with a power consumption which even exceeded 30 horsepower. Naturally such a performance required strength and rigidity in construction which is not required by high-speed steel, while the performance is of an entirely new order of magnitude.

Cemented tungsten-carbide tools are here to stay, and will fill an even more important place than was evident a year ago. In many cases, it has been the spectacular performances that have attracted attention, and they do merit attention, but it has already become clear that the new tools find their most remunerative work on "production" jobs. It is by doing the large-scale production jobs, everywhere common in American industry, that these tools have won their place. They have demonstrated their ability to take their place "in the line" on a truly commercial basis, and the results, measured in terms of increased production and reduced costs, and in terms of thousands of tools and hundreds of thousands of parts produced, speak more eloquently than words for the place cemented tungsten carbide has already attained.

* * *

TRUING BRAKE-SHOE BANDS

Two special machine units of the construction here shown are mounted on one table for truing asbestos-fiber bands of automobile brake-shoes in the Plymouth plant of the Chrysler Corporation, Detroit, Mich. The output per unit averages 250 pairs of brake-shoes an hour. In operation, the work fixture of each unit rotates slowly to carry the brake-bands *A* past a solid Stellite cutter which revolves at a speed of about 2600 revolutions per minute within housing *B*.



Machine Designed for Truing the Asbestos-fiber Bands of Automobile Brake-shoes

Loading of the work is facilitated by the use of air for holding the table spindle stationary during the loading and for operating the work-clamp spider *C* before and after loading. As each set of shoes is finished, the fixture is automatically stopped and unclamped by means of a cam arrangement connected to the clutch and the air valve. New brake-shoes are then quickly substituted for those finished, after which the handle of the air valve is moved to lower spider *C* on the work and release the table clamp so that the table can carry the new brake-shoes past the cutter. For locating the work, the four arms of spider *C* are equipped with dowel-pins that enter holes in the brake-shoes. The table is actuated through worm-gearing by the motor seen in the illustration, while the cutter-spindle is driven by a vertical motor beneath the table.

* * *

Of the 78,797 miles of Federal aid highways completed at the end of August, 6141 miles were built in Texas, 3854 in Minnesota, and 3559 in Nebraska.

Crown Gear Hobbing Fixture for Turret Lathe

A Fixture of Unusual Design Applied to a Flat Turret Lathe for Hobbing the Teeth on a Crown-Tangent-Tooth Gear

By O. S. MARSHALL

IN Fig. 1 is shown a Hartness turret lathe equipped with a special fixture for hobbing the teeth of the gear *B* which is also shown in Figs. 2 and 5. This gear is a part of the roller-feed mechanism of a flat turret lathe when equipped for bar work, and has a special form of crown-tangent tooth, as indicated in Fig. 5. Originally this gear was made of machinery steel, carburized and hardened, but it is now made from CSM alloy steel, which is so tough and hard that the speeds and feeds for hobbing had to be reduced below those obtainable on the hobbing machine regularly used for this class of work. In order to meet the new machining requirements, the set-up illustrated in Fig. 1 was designed. This equipment has given very satisfactory results.

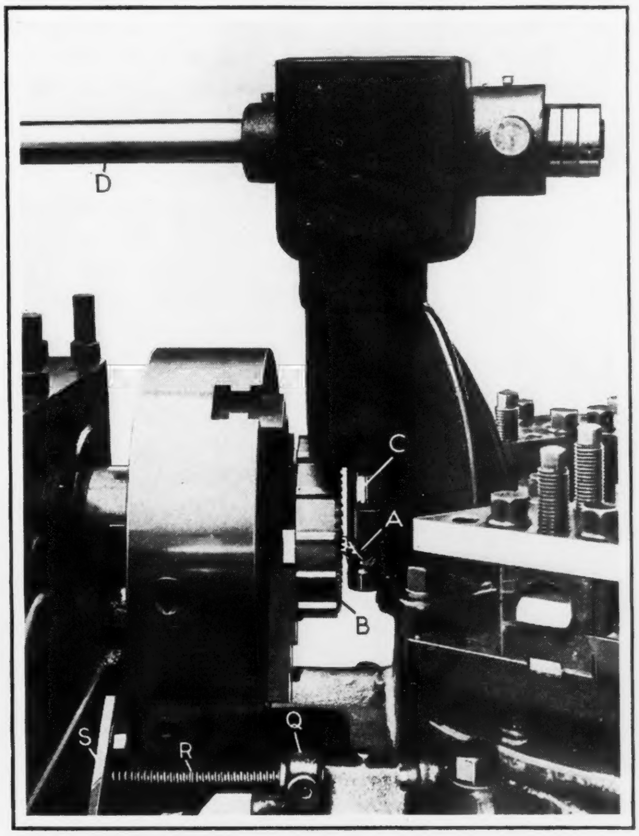


Fig. 1. Turret Lathe Equipped for Cutting Teeth of Special Crown Gear

Basically, the fixture is an application of the Hartness chasing attachment to the driving of hob *A*, Fig. 1. The spindle of the hob is connected by gearing with the machine spindle on which the work *B* is mounted, so that the work and cutter are positively driven at the correct relative speeds. The cutter-spindle *C* is operated through a shaft *D* driven from the headstock, the same as the regular thread-chasing attachment. The cutter or hob *A* is shown withdrawn a slight distance from actual cutting contact with the work, the turret having been run back so that the cutter teeth can be seen. The gear *B*, also shown in Fig. 5, has fifty-five teeth of 16 pitch. The angle of the tooth is 45 degrees. The hob, shown in Fig. 3, has sixteen teeth with seven flutes, the teeth being relieved by hand. The finished form of the tooth in the tangent gear corresponds to the segment of a circle.

Fig. 2. Front View of Gear Shown at B, Fig. 1

This shape provides a better wearing face for the driven gears, of which there are two in the feed mechanism, which operate at opposite sides of the tangent gear.

At the left, Fig. 4, is shown the gearing that transmits the drive to the hobbing fixture shaft *E* from the bevel gear *F* which meshes with the drive gear on the main spindle of the headstock. The headstock of the lathe is not shown in the illustration. The vertical shaft *G* carries another bevel gear *H* at its upper end, which drives a third bevel gear *I* mounted on shaft *E*. The bevel gear *J*, which is also mounted on shaft *E*, drives the vertical shaft *K*, on the lower end of which is mounted the hob *A*.

The supporting members *L* and *M* of the two vertical shafts are free to turn about their axes when the sliding head of the lathe is adjusted to bring the work into proper alignment with the center of the hob, a provision which is common to the chasing attachments of the turret lathe. The special tangent gear is made in three sizes to suit the various sizes of flat turret lathes, and the same fixture is used in hobbing all three gears. The gear blanks, one of which is shown by dot-and-dash lines at *P*, Fig. 4, are held in the chuck as indicated.

A stop for determining the tooth depth is shown in Fig. 1. This stop consists of an adjustable bar attached to the carriage at *Q*; a coil spring *R*, which serves as a steadying means while the carriage is being fed in for the cutting operation; and a bar *S*, fastened to the cross-slide head. The adjustable bar, enclosed by the spring *R*, coming in contact with the bar or plate *S*, serves to stop the forward movement of the turret on which

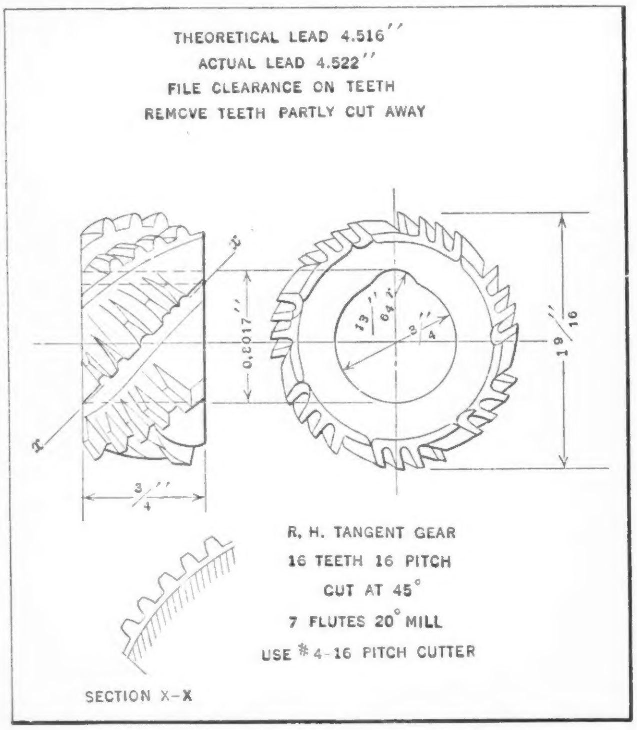


Fig. 3. Hob Used in Cutting Teeth of Special Crown Gear

the hob is mounted, and thus determines the tooth depth. With the equipment described, the teeth can be cut in each gear in about eight minutes.

DOUBLE-ACTING PUSH-FEED FOR FORMING DIES

By JOSEPH E. FENNO

Greater safety for the operator's fingers, as well as a substantial increase in production, was attained through the use of the double-action feeding device on the forming die shown in the illustration. The piece to be formed in this die is shown in the detail view, and is ejected from the die by a blast of compressed air from the hole *S*, which is connected to a regular ram-operated valve. This device, which is applicable to a great number of blank fed forming dies, is now being successfully used on over forty presses in a factory manufacturing electrical switches.

The most interesting feature of this device is the manner in which the push-slide *G* on every second downward stroke of the press, carries the blank from the magazine *J* to its position under the punch *E*. The blanks are fed by the operator from the stationary tray *I* into the magazine *J*. As the ram descends, two cam fingers *C*, acting against the lugs *F* fastened to each side of the push-slide *G*, carry the slide to the right until the bottom blank in the magazine drops on the surface *P* of the slide. The latter is a slide fit in guide ways *H* on each side of the die. The coil springs *B* carry the slide with the blank to the left as the ram ascends.

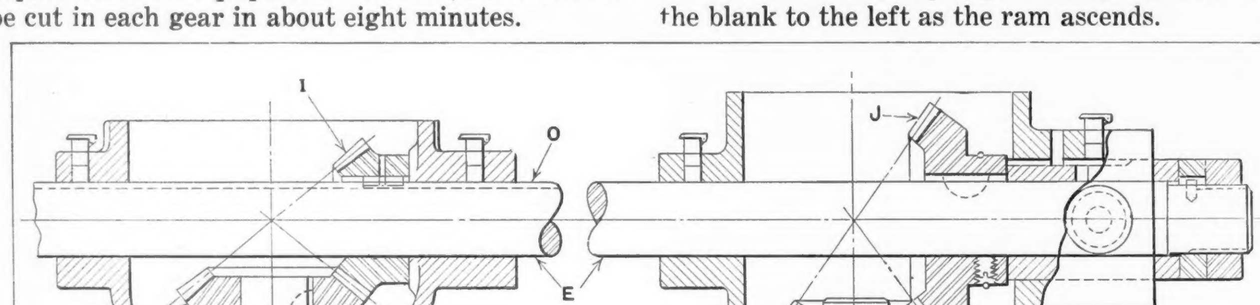


Fig. 4. Thread Chasing Attachment Modified to Meet Gear-hobbing Requirements

On the next descent of the ram, the slide G is moved to the right and the two fingers L hold the blank stationary until the edge N is past the blank, when the latter drops to the top of the die. The ram then ascends, allowing the springs B to pull the slide to the left and deposit the blank in the die nest under the punch. In the meantime, another blank has been removed from the magazine and is located against the shoulder O.

It is obvious that, with the installation of this feeding arrangement and the stationary guard M, danger to the operator has been reduced to a minimum, as it is unnecessary for him to place his hands under the punches while the press is in operation. In addition, owing to the ease of feeding the blanks into the magazine and the fact that the press is running continuously, the speed of the press can be stepped up, increasing production over that obtained with the previous hand-feeding method, when the press had to be stopped each time.

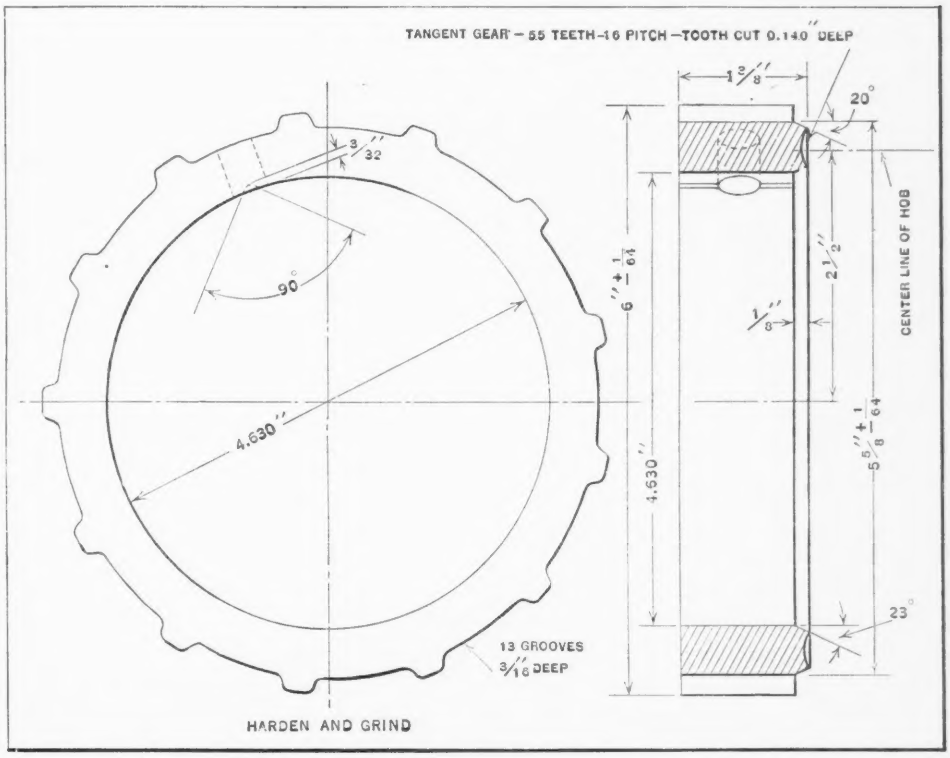
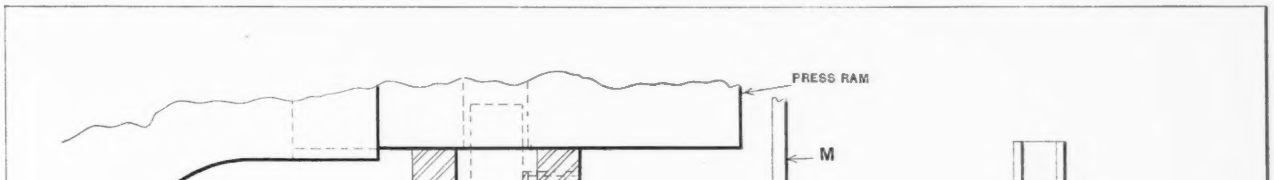


Fig. 5. Details of Crown-tangent-tooth Gear



Push-feed for Forming Die, which Requires Two Downward Strokes of the Press to Carry the Blank to the Die Nest

Machining Tapered Grooves in Roll

Method Employed in Machining Grooves in Rolls Used in the Production of Tapered Tubes

By FRANK H. MAYOH

RATHER an unusual machining operation is required in producing the tapered grooves in the roll shown in Fig. 1. Two of these rolls are mounted on the spindles of a machine described in September, 1929, MACHINERY, which is employed for rolling tapered tubes. The grooves are cut in the periphery of the roll and have a constant taper from the small radius at *C* to the large radius at *D*. The short space at *E* between the large and small ends of the groove is not tapered. The tapering of the groove is accomplished by a series of cutters, one of which is shown at *A* in Fig. 4. These tapering cutters are used after the grooves have been rough-turned to a uniform depth, as indicated in Fig. 3.

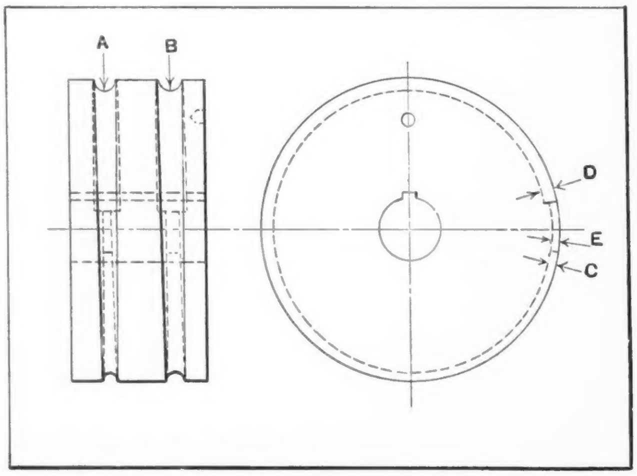


Fig. 1. Roll with Finished Tapered Grooves

Referring to Fig. 3, the grooves *B* and *C* are turned by a round-nosed cutter *D* held in the lathe toolpost *E*. The work is mounted on the arbor *F* between the centers of the lathe in the usual manner. After the grooves are turned to the depth indicated at *E*, Fig. 1, the work is held on an arbor *D* mounted on the cross-slide of the lathe, as indicated in Figs. 2 and 4. A gear *F*, Fig. 2, is also mounted on the same arbor in such a manner that it revolves with the work.

One of the tapered cutters is held in the collet *B*, Fig. 4, the small end being supported by the center *C* of the lathe tailstock. The hole *E* in the work is provided for locating purposes. The tapering operation on the groove is performed by revolving the work in the direction indicated by the arrow *H* and at the same time feeding the work in the direction indicated by arrow *G*, while in contact with the revolving cutter *A*.

The rotation of the work is accomplished by having the gear *F* in mesh with the rack *E* located directly above the cutter. Thus, as the work travels in the direction *G*, it is caused to rotate as indicated by arrow *H*. The combined movements described result in milling the tapered groove, start-

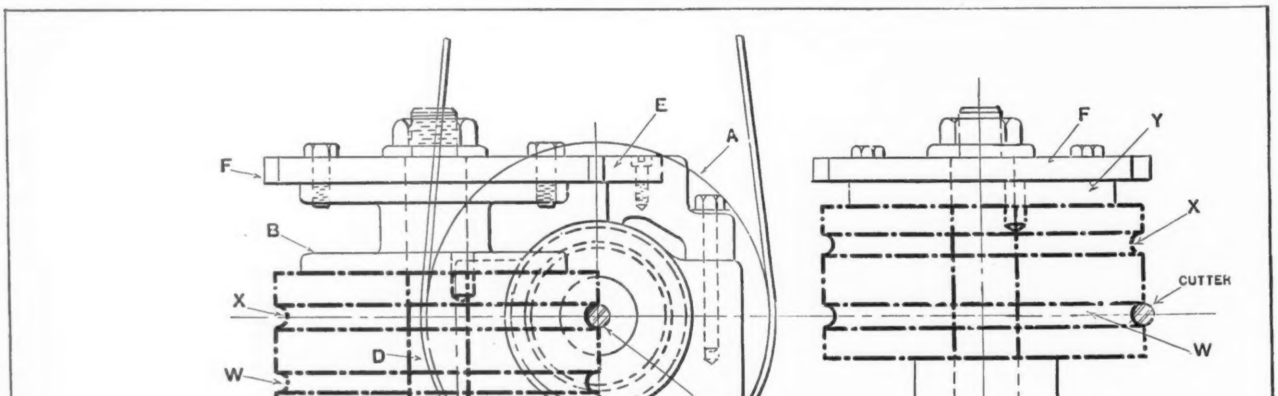


Fig. 2. End View of Set-up for Cutting Tapered Grooves in Roll

ing with the small diameter and ending with the large diameter. As the circumference of the roll is too great to be conveniently machined by one cutter, a set of four cutters is used, the smallest finishing the taper at the small end and the largest completing the work at the opposite end of the groove.

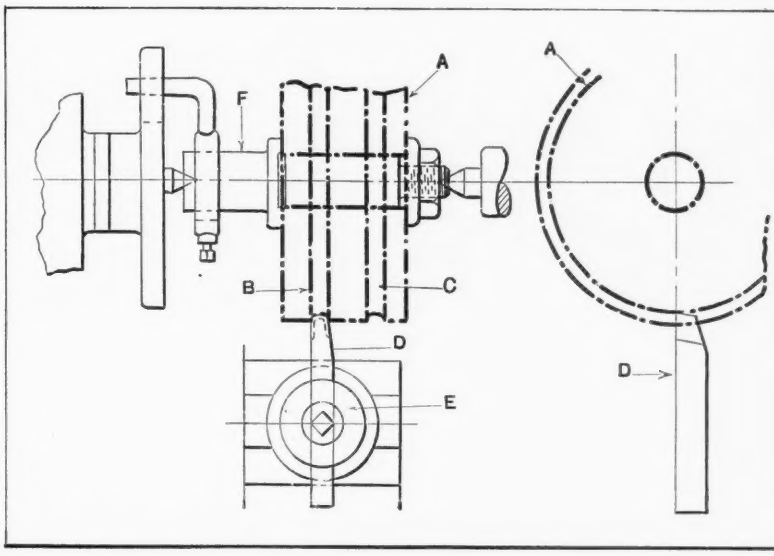


Fig. 3. Rough-grooving Rolls Preparatory to Machining Taper

After milling one-quarter of the total length of the groove or circle with the smallest cutter, the cross-slide of the lathe is run back to the starting point with the gear *F* out of mesh with the rack so that it will not be revolved. The next size cutter is then put in place, and the second quarter of the groove milled with the gear in mesh with the rack. This operation is repeated with the two remaining cutters, thus completing the tapered groove. Great care must, of course, be taken to start each milling cutter exactly where the preceding one left off.

The end view in Fig. 2 shows the rack *E* in engagement with the gear *F*. The method of holding the rack in a bracket *A* which is secured to the headstock is also shown in this illustration. The gear *F* is held by screws to a flange *B* with which the gear turns as a unit. The cutter is shown at the left in the working position for milling the groove *X*. When groove *W* is being milled, the collar *Z* shown at the right is used to raise the work to the required height, and gear *F* is secured to a thin plate *Y* instead of to the flange collar *B*.

The handwheel *S* is used to feed the cross-slide *T* in or out as required when starting the work. It

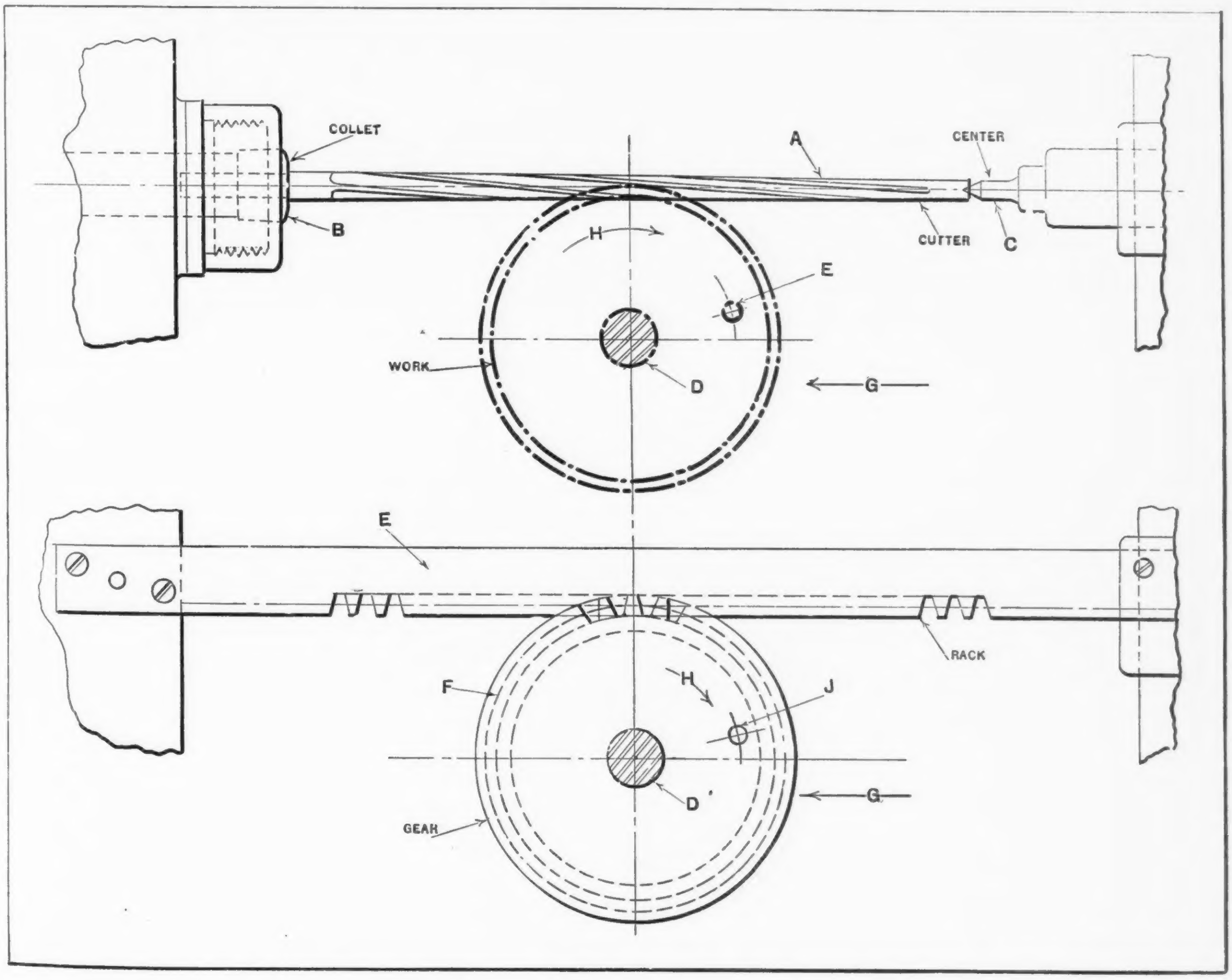


Fig. 4. Diagrams Showing Method of Cutting Tapered Grooves in Roll

is necessary to have the gear in mesh with the rack at all times when cutting the groove, although it is not in mesh when running the cross-slide back. The number of teeth in the gear should be a multiple of four when using four cutters, as described. If three cutters are used, the number of teeth in the gear should be a multiple of three.

By means of the pin used to locate the work, and scribed lines passing through the center of the gear teeth at each quarter section, it it possible to line up the work accurately for each cut. By having these lines coincide with the lines at the starting point on the rack and by having a starting line on the cutters under the rack line, the required settings can be quickly and accurately made.

* * *

PRODUCTION OF HIGH-STRENGTH CAST IRON

Nickel, chromium, and molybdenum are the three alloying elements most commonly used in producing high-strength cast iron; other alloys contain vanadium, maganese, and copper. Some of the processes used are patented, and the products are known by trade names. One of these metals, as described in an article in the *S. A. E. Journal,* is known as "Meehanite," and is produced by a refinement of the ordinary process employed in making semi-steel. The resulting metal is readily machineable, close-grained, homogeneous, and free from chilled edges and hard spots.

The Meehanite process consists mainly in controlling the scrap, which is melted in an ordinary cupola, and in treating the molten metal at the ladle with an inexpensive electric-furnace compound of calcium. As this compound is applied at the ladle, it is possible to obtain varied qualities of iron from the same heat of the furnace. Meehanite can be produced at approximately the same cost as other automobile castings, but its production requires careful metallurgical supervision.

The ultimate strength and yield point of ordinary cupola Meehanite metal is said to be 46,000 pounds per square inch; the elongation, 5 per cent; and the Brinell hardness, 255. The modulus of elasticity is 27,600,000 and the resistance to corrosion under ordinary atmospheric conditions is said to be 70 per cent greater than that of cast iron. The melting range is from 1360 to 1380 degrees C. (2480 to 2516 degrees F.), and high strength is retained at temperatures up to 1200 degrees F.

Effect of Heat-treatment on Meehanite

By heating Meehanite from 1570 to 1600 degrees F. and cooling in air, the yield point is increased to 85,000 pounds per square inch, and the ultimate strength, to 90,000 pounds per square inch, with a modulus of elasticity of 29,600,000. Quenching in oil or water makes the material glass-hard, producing a superior material for valve tappets and sleeve valves.

Annealing at a temperature of 1570 to 1600 degrees F. gives an elongation of 4 per cent and a reduction of area of 5.4 per cent, with a Brinell hardness of 140, a modulus of elasticity of 21,200,-000, and a slightly lower yield point and ultimate strength than in the original metal. This material is referred to as semi-malleable Meehanite, and is said to have an impact strength of 3295, while that of cast iron is 61.

Methods of Adding Nickel to Cast Iron

Nickel can be added to cast iron either in the mix or at the ladle. Pig iron is available in a natural alloy containing both nickel and chromium. This is used by a large number of foundries in quantities of, say, 5 per cent of the total charge. Another way of adding nickel in the mix is by the use of specially prepared blocks of nickel that have a melting point lower than the pouring temperature of gray cast iron. This is said to assure an even mixture. The same kind of prepared nickel is also furnished in the form of shot that can be added to the iron at the ladle.

The mixture of iron has to be modified or changed according to the thickness of the section to be cast. It is not to be expected that the same material will be easily machineable in a thin section or perfectly dense in a heavier section, but lack of uniformity in different sections can be greatly reduced by the introduction of alloys that are used as modifying agents rather than as the backbone of the mixture.

Gunite—a Wear-resisting Iron

An iron that is particularly well suited for use in brake-drums and clutch plates is known as "Gunite." Melting in an air furnace is necessary to secure uniform results with this material. Tests for wearing qualities show that the flake graphite contained in Gunite assists considerably in reducing the wear on both the brake-drum and the brake linings.

The Bethlehem Steel Co. produces a pig iron containing both nickel and chromium. One alloy pig iron contains not more than 2 1/2 per cent of carbon, with 7 to 10 per cent silicon and from 2 to 2 1/2 per cent manganese. It is said that this high silicon and manganese content makes it possible to use sufficient steel scrap to produce high-strength cast iron without requiring expert control over the production methods.

* * *

FRANKLIN MEMORIAL MUSEUM

There is to be erected in Philadelphia, under the auspices of The Franklin Institute and the Benjamin Franklin Memorial, Inc., a monumental architectural memorial to Benjamin Franklin with a collection portraying the graphic arts as they were in Franklin's time and showing also their development to the present time—a great scientific and technologic museum similar to the scientific museums of Europe. The fundamental purpose of the museum will be the portrayal and elucidation of scientific principles. Charts, photographs, motion picture films, models and, where possible, apparatus itself will be used in setting forth the developments to be recorded.

The Use of Cold-rolled Steel Strip Stock

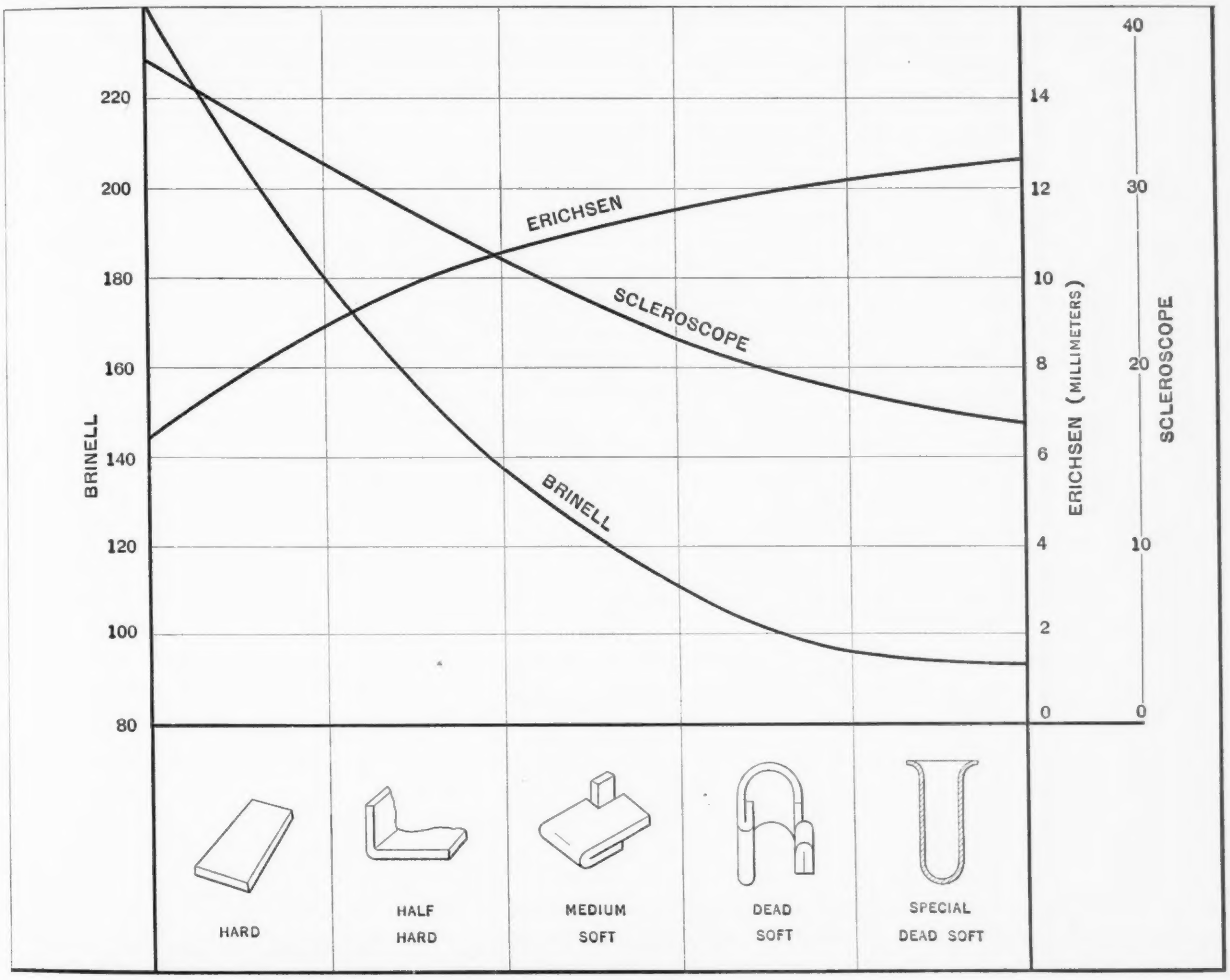
Characteristics of the Different Grades of Bright Cold-rolled Strip Stock and the Kinds of Press Operations for which They are Adapted

By R. H. VIE

BRIGHT cold-rolled strip stock is used for a variety of products, in the manufacture of which it is subjected to all kinds of press operations. This material is obtainable in various grades, and the quality of the work and the life of the press tools depend to a large extent on the grade of stock selected. Trouble from fracturing, which sometimes occurs during forming or cupping operations, can generally be avoided by using the proper grade of stock. However, some engineers fail to take into consideration the different degrees of hardness in which this material is obtainable, and the changes that can be made in the hardness by suitable rolling and tempering.

Probably the composition of bright rolled strip stock is not very generally known. Three different samples subjected to analyses indicate that it should be classed as a very mild steel, having an exceedingly small percentage of sulphur and phosphorus. The analyses of the three samples, designated A, B, and C, are given in Table 1.

Five different tempers are used commercially, designated as hard rolled, half hard, medium soft, dead soft, and special dead soft. By using a material having the proper temper for the particular job in hand, no trouble should be encountered.



Diagrams Showing to what Extent Different Grades of Cold-rolled Strip Stock can be Worked; and Curves Plotted to Indicate the Equivalent Hardness Values of the Various Grades in Erichsen, Scleroscope, and Brinell Numbers

Properties of Hard-rolled Material

Material of this temper or grade fractures so easily that it cannot be used for any part that is to be bent, formed, or drawn. The hardness of this material approaches the maximum for mild steel. It can be blanked and pierced neatly, and the edges produced in this manner are sharp and

even. In this respect, it is the best blanking material of the five grades ordinarily used. In some cases, when it is necessary to have very fine edges for a formed or drawn part, the hard-rolled temper is chosen. Then the part is blanked, after which it is annealed and drawn in one or more operations. On no account, however, should an attempt be made to bend or form the hard-rolled strip stock prior to annealing.

Bending Properties of Half Hard and Medium Soft Grades

The half hard material blanks well and will also take a sharp right-angle bend in a transverse direction relative to the grain. The latter property should be kept in mind, as ordinarily it will be found impossible to make two right-angle bends at right angles to each other.

The medium soft material will take a sharp right-angle bend along the grain and a complete 180-degree bend or closure in a transverse direction. It is suitable for frameworks which have to be bent into bearing arms at right angles to the main body, but in different directions. The properties of this grade of material are such that no sharp right-angle bend will fracture it, unless, of course, the forming tools are so made that they tear the material at the corners.

Grades of Material Used for Drawn Parts

The material of the grade known as dead soft will take 180-degree folds both with and across the rolling grain, and is used for cupped or shallow drawn work. For general purposes, this is one of the most commonly used materials.

The special dead soft grade is mild steel in its very softest condition, which means that annealing does not improve its deep-drawing qualities. Experiments have shown, however, that when this dead soft material is thinly plated with copper, the lubricating action on the dies produced by the latter metal renders it possible to increase the depth of the draw.

Table 1. Composition of Three Grades of Cold-rolled Steel Strip Stock

Element	Brand A	Brand B	Brand C
Carbon, Per Cent	0.11	0.10	0.07
Manganese, Per Cent	0.40	0.45	0.34
Silicon, Per Cent	0.03	0.01	0.02
Sulphur, Per Cent	Traces	0.01	0.01
Phosphorus, Per Cent	0.01	0.01	0.01

Machinery

The special dead soft material, which is used when the maximum depth of draw is desired, does not blank at all well. Actually this property is of little importance, since the tops of nearly all deep drawn shells are subjected to a final shearing operation. Nevertheless, some manufacturers prefer to start with a harder material and anneal it to meet requirements as the work progresses. This procedure gives satisfactory results when a modern annealing furnace, in which the heat can be evenly maintained, is used. However, it requires careful annealing to reduce the hardness of a mild steel to its minimum value.

The comparative hardness of the five different grades of cold-rolled steel strip stock is given in Table 2. No limits have been given in the tabulation, as they might easily be misinterpreted. For ordinary purposes, a practical test on a small piece of strip stock is adequate, if carried out by one experienced in such work. The accompanying chart shows at a glance the equivalent hardness ratings of the Brinell, scleroscope, and Erichsen scales. The diagrams at the bottom of the chart indicate the various types of bends to which each particular grade may be subjected without danger of fracture. The hardness ratings that fall within the dividing lines separating the different grades must be taken as approximate for the Brinell, scleroscope, and Erichsen testing machines, which operate on different principles.

Table 2. Comparative Hardness of Different Grades of Cold-rolled Steel Strip Stock

Grade	Brinell, Number	Erichsen, Millimeters	Scleroscope
Hard	210	7.8	34.5
Half hard	156	10.1	27.5
Medium soft	126	11.0	24.0
Dead soft	99	12.0	19.0
Special dead soft	94	12.6	18.0

Machinery

In considering press work, the writer believes it is best to take the Erichsen rating as standard and check it by means of the other two. When considerable cold work is to be performed and annealing cannot be carried out fully, the Herbert pendulum hardness tester will be found useful, as it assists in estimating the amount of cold work the material will withstand.

* * *

COSTLY AIRPLANE PROPELLER TEST UNIT

Much interesting research and development work connected with aviation is done by the Army Air Corps at Wright Field, where, according to an article by Brigadier-General W. E. Gillmore in the *S.A.E. Journal*, the propeller test unit is recognized as one of the most important, and also one of the noisiest, units on this field. Failure of a propeller may easily wreck an engine and possibly cause disaster. It is imperative that propellers be constructed of the best obtainable material by the best workmen available and given exhaustive tests to destruction.

The newest type of apparatus used at Wright Field provides for one test stand of 6000 horsepower capacity having clearance for a 40-foot diameter blade, a smaller one of 3000 horsepower capacity at 1800 revolutions per minute, and one of 2500 horsepower capacity at the high rotative speed of 4300 revolutions per minute. The equipment of this propeller test unit costs more than $550,000.

Checking Gear Teeth for Smoother Operation*

Methods and Fixtures Used in Checking the Concentricity and Uniformity of Spaces and Thicknesses of the Teeth

By E. N. TWOGOOD, General Electric Co., Lynn, Mass.

A RELIABLE method of checking the uniformity of the spaces between both helical and spur gear teeth would also provide a means for verifying the accuracy of the gear-cutting machine. Such a method, to be described, was developed within the General Electric Co.'s organization by F. L. Pearson.

The gear to be checked is supported in a horizontal position on its journals in V-blocks, as shown in Fig. 2. A short pin is placed between two adjacent teeth at the top of the gear. This pin should be straight, of accurate round cross-section, and of such a diameter that it will contact with the teeth approximately at the pitch line. The knife-edge support *A* is fastened to the base, parallel with the axis of the gear. A wide straightedge *B* is placed so that its only supports are the knife-edge and the pin, permitting it to pivot within a reasonable arc about the knife-edge.

A dial indicator, graduated in tenths of a thousandth of an inch, is fastened to member *C* and is located over the straightedge just above the center of the gear. The indicator, which is set at zero, will show any change in the distance from the straightedge to the axis of the gear. The gear is now rotated slowly back and forth, and a record made of the reading on the indicator corresponding to the highest position of the straightedge. The pin is then placed in each of the other tooth spaces and similar readings recorded.

The plotting of these readings in rectangular coordinates would give a straight line for a gear having no errors in the spacing and concentricity. A curve following the general shape of a sine curve indicates eccentricity. Abrupt changes in the curve would show irregularity in the spacing, and the periodic recurrence of these changes in relation to one revolution of the gear may identify the member in the hobbing machine causing the trouble; this member would have the same period with respect to the revolutions of the blank.

Such a curve will show very clearly the actual conditions of the gear, as it gives directly the error from tooth to tooth as well as the accumulative error. This eliminates any estimating of the accuracy of the spacing by averaging the accumulative error over the number of teeth, a procedure that does not often give a true condition. Sets of readings using a common zero setting for the indicator and taken in different planes along the helix of the gear give, when plotted in polar coordinates, an accurate representation of the spacing, concen-

*Abstract of a paper read before the Mechanical Section of the Engineers Society of Western Pennsylvania.

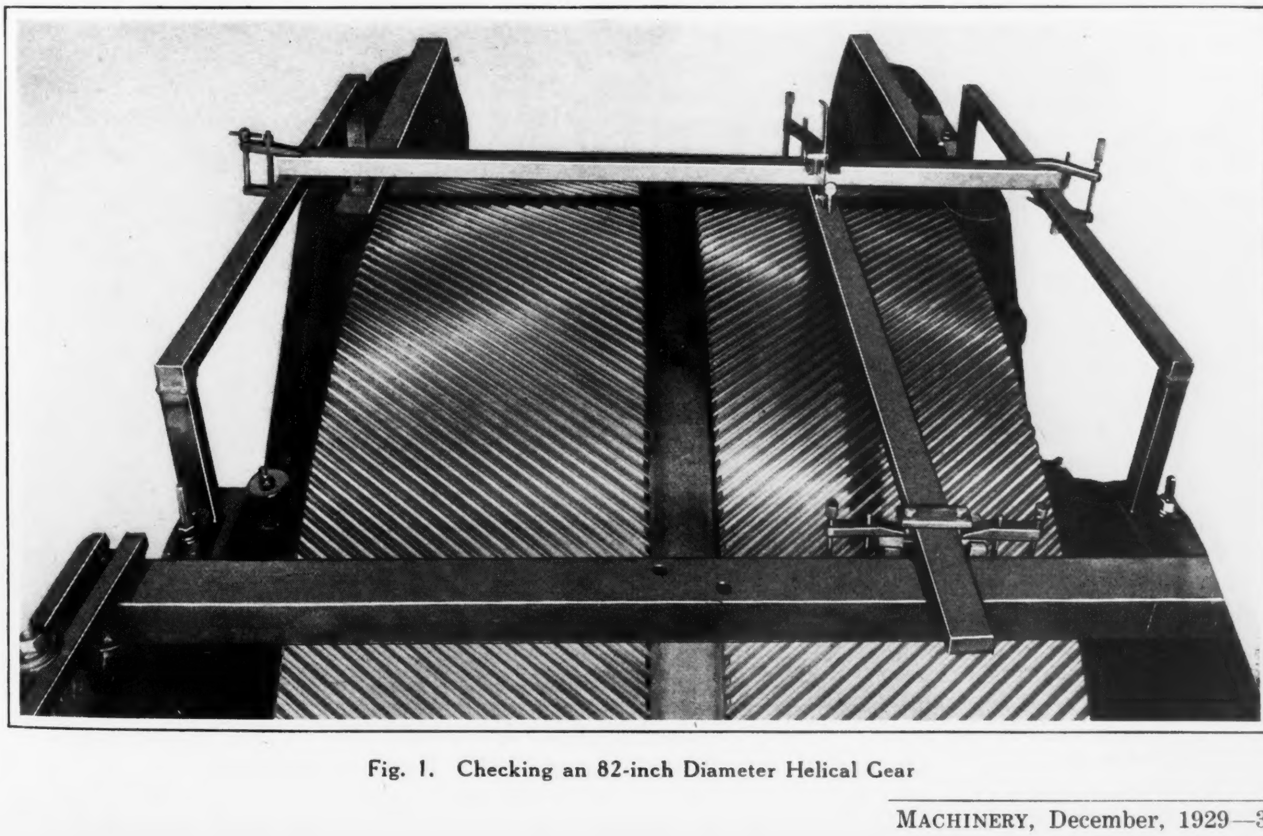


Fig. 1. Checking an 82-inch Diameter Helical Gear

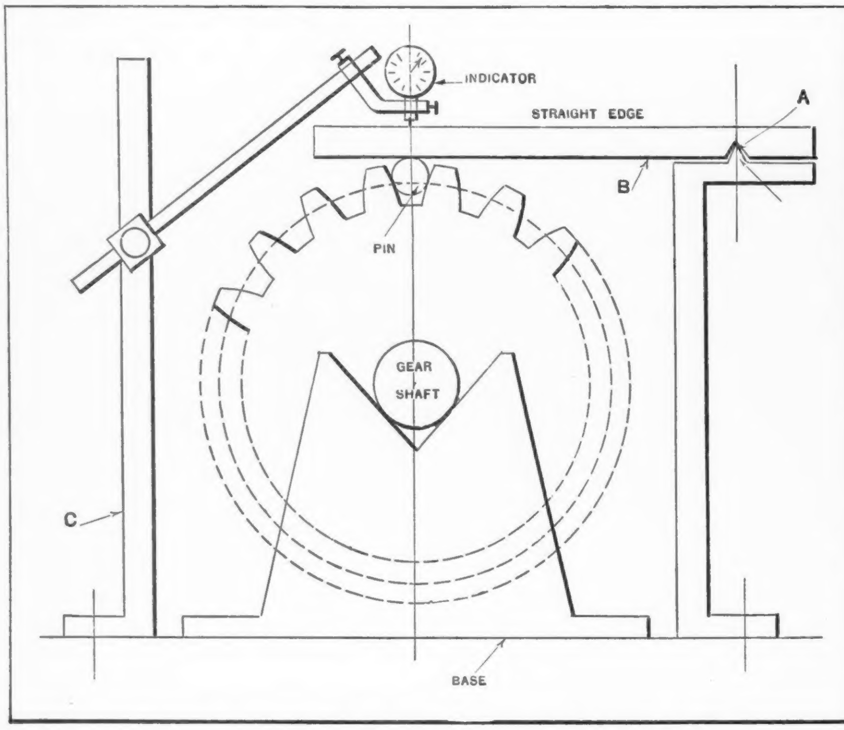


Fig. 2. Arrangement for Checking the Concentricity and Uniformity of Spacing of Gear Teeth in Relation to the Axis of the Gear

tricity, and uniformity of thickness of the teeth for the helix of the gear.

This method of checking is also an accurate and convenient means of establishing the relative amount of wear on the teeth around the circumference of the pinion. This may be of particular interest in the case of gear units which, during their service, have developed a case of rough operation that cannot be corrected by testing the accuracy in the line-up of the gear members relative to one another, or to the unit to which the gear is coupled, and where the condition of the teeth by direct observation does not show any cause for rough operation. When tests are made in the manner described, the results are more clearly shown by plotting the readings in polar coordinates.

In Figs. 1 and 3 are shown two typical set-ups illustrating the use of the methods described. The helical gear being checked in Fig. 1 is 82 inches in diameter.

* * *

A molding material that can be more readily molded into complicated forms than ordinary Bakelite, is reported to have been developed by the Bakelite Corporation. This material is said to have a higher specific electrical resistance than Bakelite.

CHEVROLET APPRENTICE SHOP

According to a recent announcement, the Chevrolet Motor Co. will soon open an apprentice shop in Flint, Mich., for training a class of fifty young men between the ages of sixteen and nineteen years. This project, which is to be known as the "Chevrolet Apprentice Shop," is considered a necessity in view of the increasing shortage of all-around mechanics. The shop will occupy a one-story building, 60 by 160 feet, which is now under construction. Apprentices who are not high school graduates will be required to complete about 10,000 hours of training. Those who are high school graduates are expected to complete their training in two-thirds this time. The apprentice will work fifty hours per week, and will be paid from the outset, regular increases in salary being given as he advances. Regular shop discipline and shop working hours will be maintained.

* * *

Argentina continues to be the leading market for American passenger cars, followed by Australia, Canada, and British South Africa.

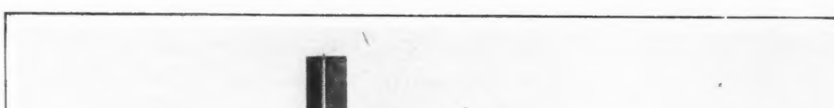
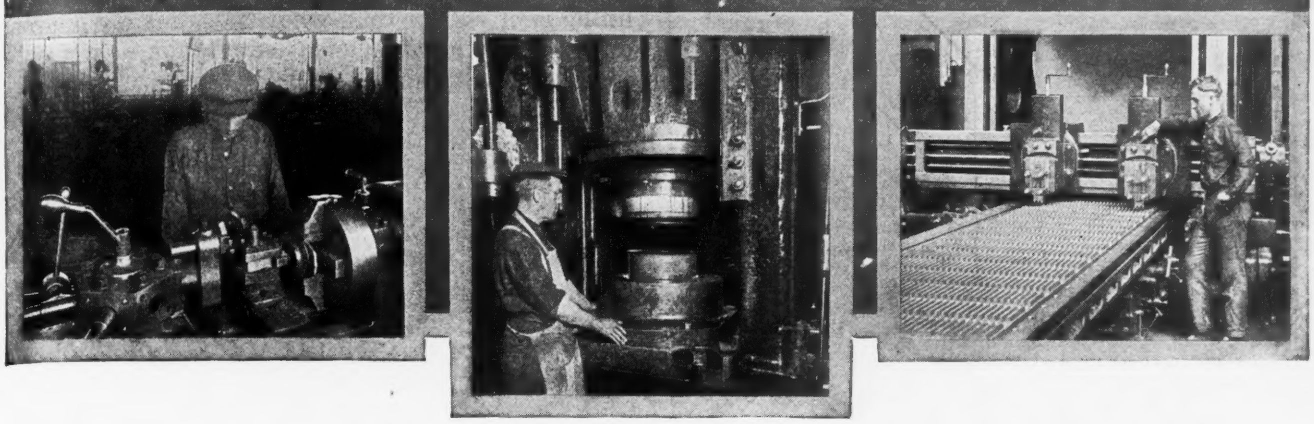


Fig. 3. Another Example Showing Set-up for Checking Helical Gear, with Side Angle Bar for Supporting Dial Indicator

Letters on Practical Subjects



GAGE FOR TESTING SMALL ASSEMBLIES

When several parts are assembled to form a complete unit, it is often necessary to check the relative positions of the parts or their actuating surfaces. The unit shown by the heavy dot-and-dash lines at *A* in the accompanying illustration comprises two parts. One part consists of a hub with a single gear tooth. The other part, which is assembled on the hub, is in the form of a flat lever having two projecting arms. The center hole, the small hole in the arm, the milled face of the other arm, and the tooth on the hub must all be properly positioned with respect to each other.

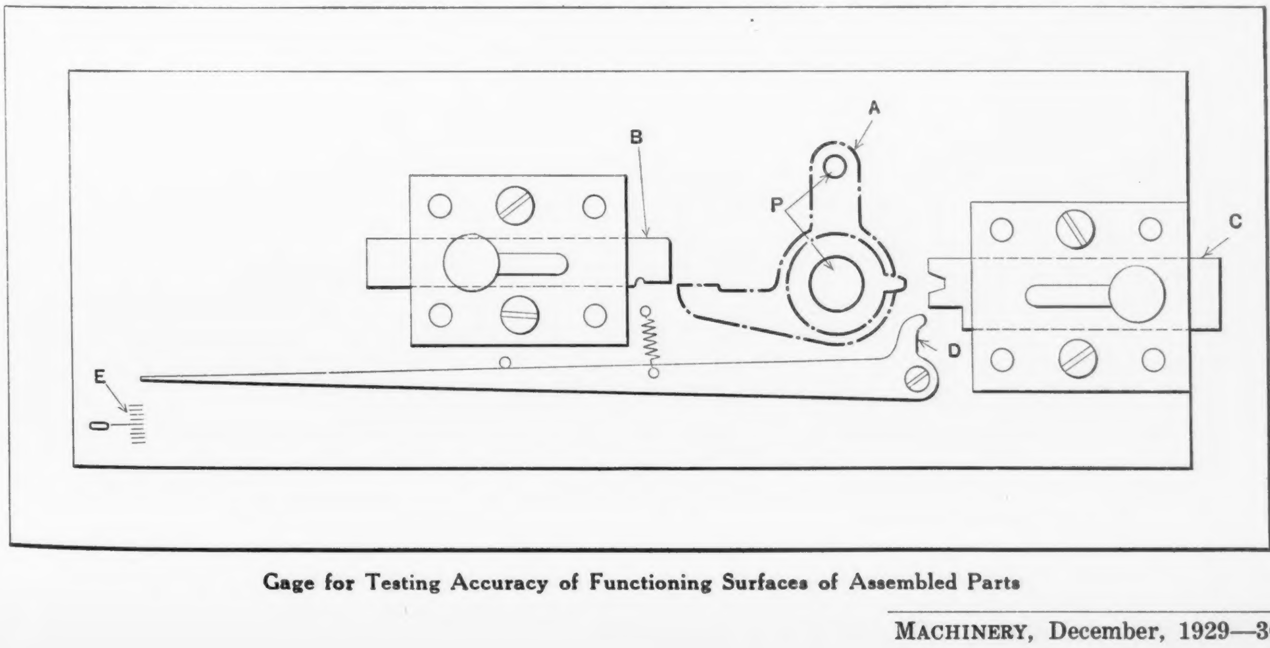
In performing the gaging operation, the assembly is located on two pins *P*. The slide *B* serves to gage the flat milled surface on the arm. The slide *C*, when moved forward to engage the tooth, comes in contact with the indicator arm *D*. By means of the indicator point on the scale *E* it can be determined whether or not the tooth is in the correct position with respect to the other working points or surfaces.

New Britain, Conn. SVEND J. HELWEG

DIE FOR BENDING ANGLE-IRONS

In designing bending dies, it is necessary to provide means for preventing the blank from slipping during the bending operation. This is particularly important in the case of dies of the V-block type. Such dies are very satisfactory for bending sheet-metal parts, as the pressure exerted by the punch on the work can be easily regulated by adjusting the ram of the press. Adjustments of this kind are sometimes necessary in order to correct variations in the angle formed on the work which are the result of non-uniformity in the hardness of the stock.

Means must also be provided for holding each blank in the same position during the bending operation in order to obtain uniform work. An inexpensive, yet effective, V-block die for accomplishing this purpose when forming angle-pieces like the one shown at *W*, Fig. 2, is shown in Fig. 1. This die is provided with a spring plunger *E* for holding the blank. The die consists chiefly of the punch *A*, die-shoe *B*, V-block *C*, spring plunger *E*, springs *F*, and the work-locating pieces *G*. The



Gage for Testing Accuracy of Functioning Surfaces of Assembled Parts

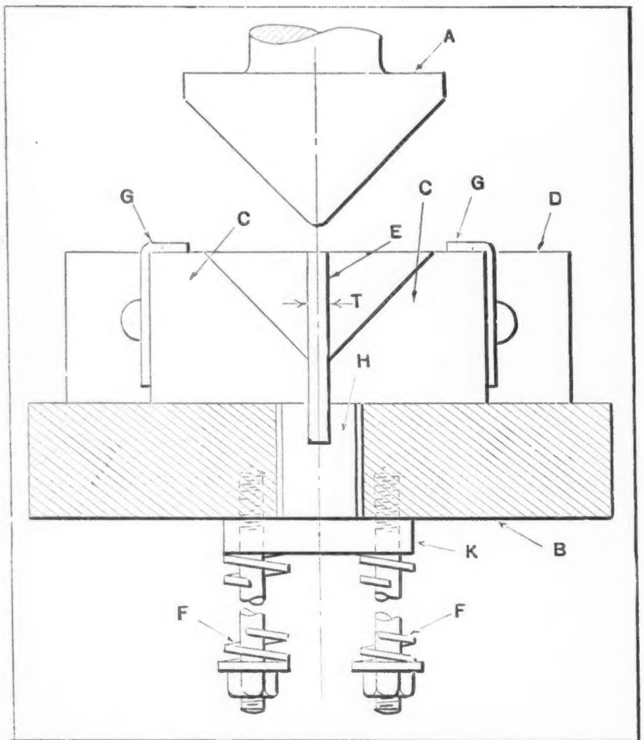


Fig. 1. V-block Type of Bending Die for Forming Angles W, Fig. 2

V-block *C* is made in two sections, and is inserted in the steel members *D*, which keep the sections from spreading apart.

Fig. 2 is a plan view of the die, and Fig. 1 is a partial cross-section of the punch and die, with one of the steel members *D* removed. The blank to be bent is placed on top of the die, where it is located by the pieces *G*. It is held in place between the punch and the spring plunger *E* during the bending operation, the plunger being forced down by the descending punch, which acts against the tension of springs *F*. The lower end of spring plunger *E* is inserted in a soft steel block *H*. This construction provides a larger bearing surface on the spring pad *K* and insures satisfactory operation.

The thickness of the stock from which the parts are made and the size of the radius at the end of the punch must be considered when proportioning the width *T* of the spring plunger, because if the spring plunger is made too wide, the slot at the bottom of the V-block may leave marks on the work. In this type of die, the work tends to form around the radius at the end of the punch. Thus, if the stock from which the parts are made is thin, and the radius of the punch small, a spring plunger of sufficient width to hold the work satisfactorily without leaving marks can be employed. The holes in the angle-irons are pierced previous to the bending operation.

Detroit, Mich. G. RUNQUIST

RUBBER AS A BEARING MATERIAL

Rubber has been the standard lining for fire hose for many years. The volume of water that can be delivered through a pipe of a given inside diameter and at a given pressure is much greater where the lining is of rubber than when the walls are of iron, owing to the low coefficient of friction of wet rubber. The friction developed when water passes through an iron pipe of good quality is about 50 per cent greater than that developed when it passes through a rubber-lined hose having the same inside diameter.

The rubber bearings that are now available owe their success to the slipperiness of rubber when wet. They are a product in which soft rubber is vulcanized within a bronze shell, the periphery of which is concentric with the bore. Rubber bearings of this type have proved successful for underwater marine work, and for turbines, centrifugal pumps, agitators, and washing machines. The bore of these bearings ranges from 36 inches down to 1 inch. Stock bearings of 1 inch and larger are available in regular shaft sizes, and are made in both flanged and cylindrical shell types.

Rubber is a truly oilless bearing material, and lubricants other than water quickly soften the rubber and destroy the bearing; but running dry for the shortest period, even in starting, is detrimental to the life of rubber, and a roughened shaft will also cut it out quickly. However, properly used bearings have operated for long periods of time under severe loads.

Not the least of its good qualities is that of shaft protection; that is, the rubber itself cannot score any shaft. The yielding nature of the rubber prevents the shaft or bearing from being damaged when struck by hard or sharp substances. Gritty matter cannot harm bearings of this type, as the continual washing or flushing effect of the water prevents such substances from gathering on the shaft or bearing. Practically 50 per cent of the interior surface of a rubber bearing is represented

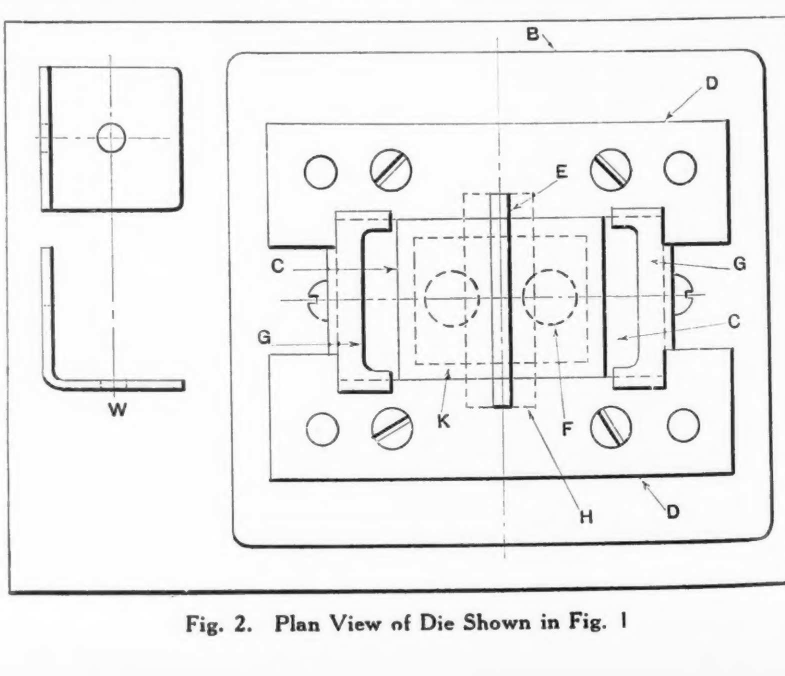


Fig. 2. Plan View of Die Shown in Fig. 1

by spiral or longitudinal grooves through which water flows or is forced.

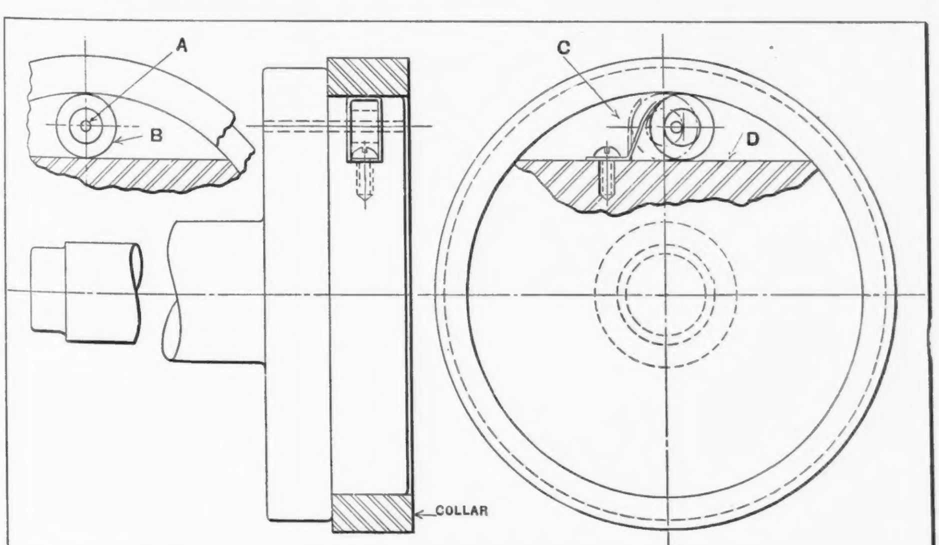
Trouble from rusting is overcome by using shafts of drawn nickel or stainless steel with rubber bearings. Domestic and industrial liquid-handling equipment can, in many cases, be improved by suitable application of rubber bearings. High speeds are essential to success with this type of bearing, a speed of from 100 feet per minute upward being recommended. Great accuracy is not often essential in the field in which such bearings are applicable, and the clearance required is about double that generally employed for metal bearings. Although vulcanized rubber is relatively non-compressible, bearings made from it are well adapted to absorb shock loads. D. A. H.

ROLLER ARBOR FOR COLLARS

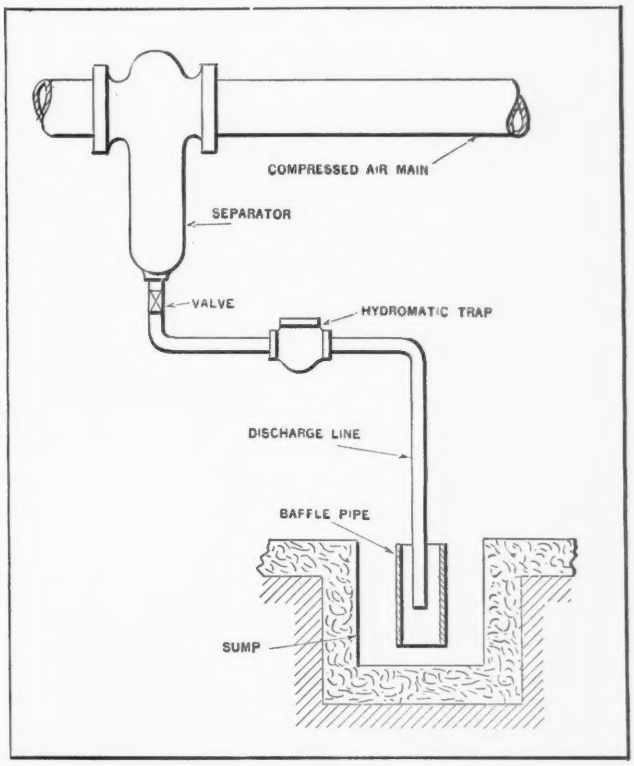
Some time ago the writer was called upon to redesign a collar arbor which had been giving trouble in the shop. Upon examination, it was found that the retaining pin *A* was located directly on the center line, as shown in the upper left-hand corner in the illustration, thus making it difficult to load the collar on the arbor without adjusting the roller *B* each time. Also, because of the difference between the diameter of the pin *A* and the hole in the roller, the roller would protrude from the slot. Finally, the roller did not have sufficient side travel to permit binding when the bore of the collars was large.

To overcome these troubles, the roller arrangement was changed to that shown at *C*. The retaining pin was offset, thus increasing the side travel of the roller and permitting binding action only against the pressure of the cutting tool. The flat spring was added to provide instant binding action when the operator once released his hold on the collar, and to retain the roller against the surface *D* when the collar was removed.

Glen Ridge, N. J. J. E. FENNO



Improved Design of Roller Arbor for Collars



Method Used to Remove Oil and Water from Compressed Air Line

AUTOMATIC REMOVAL OF CONDENSATE FROM AIR LINES

Condensate traps on high-pressure air lines will remain effective as long as the condensate is drained off at regular intervals. If this is neglected, the oil and water will back up and fill the air branch pipes, passing out through the air-operated tools. The tools are generally connected with the branch lines by rubber hose, and as the latter deteriorates rapidly under the chemical action of oil and water, the result will be a high loss of air through leakage. This loss can be estimated at about five cents per thousand cubic feet. The replacement of the hose should also be considered.

To eliminate these losses caused by neglect to drain the condensate, a method of automatically emptying the liquid chamber of the separator has been devised, as shown in the illustration. The drain line of the separator is equipped with a hydromatic trap, as indicated, and the drain from this trap leads to a nearby sump or storm drain. To prevent splashing when the liquid is forced out through the trap, a larger pipe is installed at the end of the drain pipe. The valve between the trap and the separator is always open, and is installed to facilitate

trap repairs. In a case where the sump empties into a river or stream, it may be advisable to install a grease trap in the system to remove the oil and grease from the water, or the drainage in the sump may be pumped through a septic tank in order to meet the requirements of state or local ordinances. H. C. CHARLES

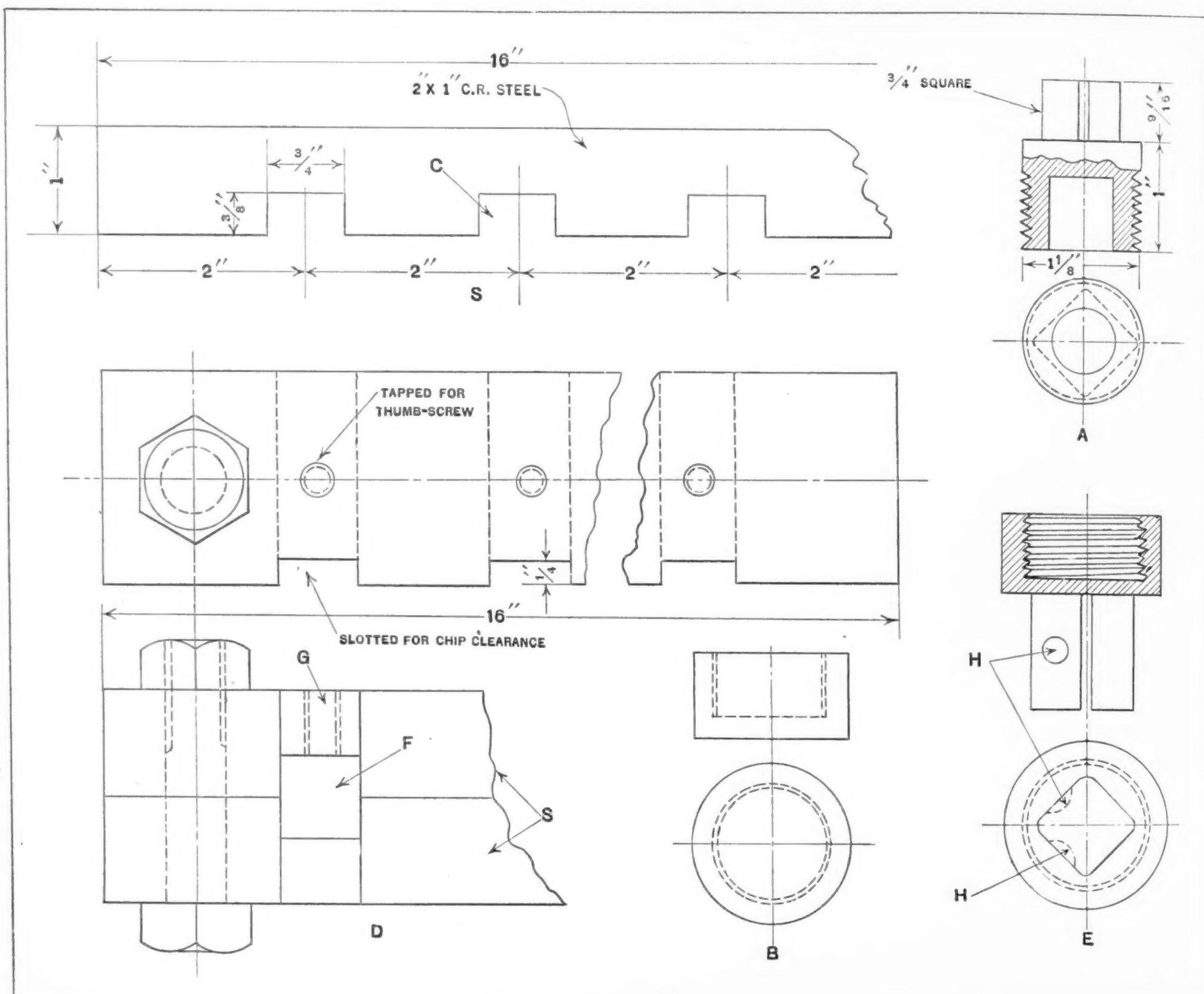
FIXTURE FOR MILLING SQUARES ON THREADED PLUGS

The fixture to be described was devised for use in milling 3/4-inch squares on 2000 threaded plugs of the type shown at *A* in the illustration. The first method tried out consisted of screwing the plug into a threaded cup-shaped fixture like the one shown at *B*, holding the cup in the dividing head chuck, and indexing 90 degrees for the second cut taken by the straddle-milling cutters. This method resulted in accurate work, but was entirely too slow, only eighteen or twenty pieces being finished per hour.

To increase production, a fixture was made up of two pieces of flat cold-rolled steel *S*. A row of slots *C* was milled across the faces of these pieces, after which the pieces were bolted together, as shown at *D*, forming square slots *F*. A clearance slot for chips was also cut at the bottom of each slot *F*. Seven receptacles like the one shown at *E* were then made up to fit into the slots *F*. The tapped holes *G* were provided with thumb-screws to hold the receptacles in place. The receptacles were all spot-drilled, as indicated at *H*, to receive the ends of the thumb-screws.

A Stillson wrench was used to screw the plugs firmly in place, with their ends resting on the bottom of the threaded holes in the receptacles. As soon as one of the pieces passed a safe distance beyond the cutters, the thumb-screw was loosened and the receptacle given a quarter turn, to bring the work into position for the second cut. At the end of the feeding movement, the milling machine table was lowered, rapidly traversed to the starting point, and raised into position for the second cut. After the second cut, which completed the squares, the work was removed with a wrench and the receptacles filled with a new lot of plugs. With a little experience, the operator succeeded in attaining a maximum production of sixty finished pieces per hour.

Baltimore, Md. RAYMOND H. DAUTERICH



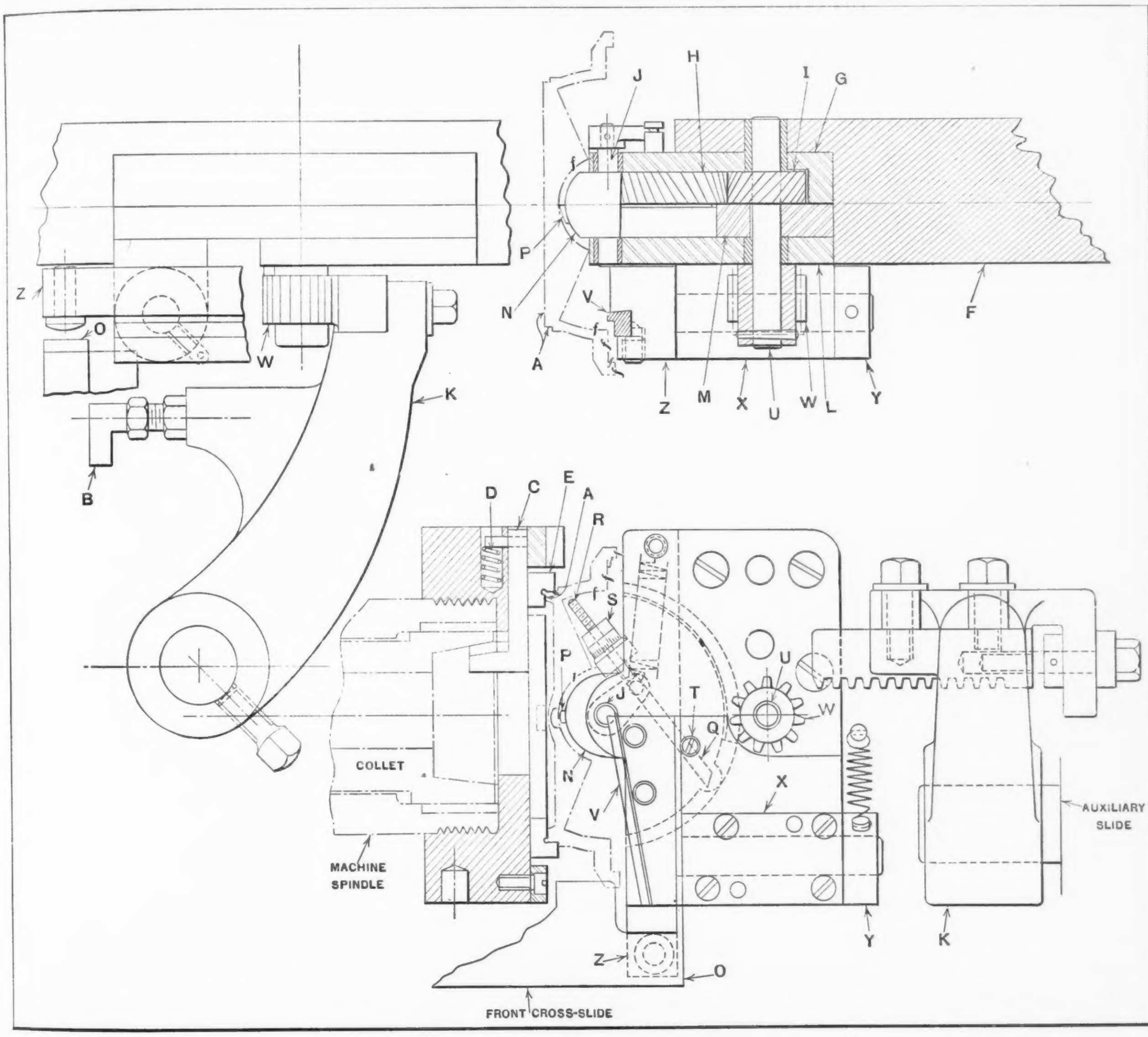
Details of Fixture Used in Milling Squares on Threaded Plugs

MACHINING SPHERICAL SURFACES IN A SCREW MACHINE

A rather unusual tooling equipment for rapidly machining two spherical surfaces and two facings of part of a water measuring device in a Brown & Sharpe No. 2 screw machine is shown in the illustration. The brass part, indicated by dot-and-dash lines, is machined to the finish marks shown, the dimensions being held to very close limits. To obtain this accuracy, two machines with similar equipment are provided, all the roughing being done on one machine, while the finishing is done on the other.

The casting, which has been previously machined at *A* to form a finished seat for the screw machine operations, is placed in a specially designed chuck screwed on the machine spindle. The machine is equipped with a special tripping arrangement and brake which stops the spindle from revolving simultaneously with the opening of the chuck to facilitate loading and removing the work. The standard collet, when moved to the right on the chucking stroke, engages the taper on the three equally spaced plates *C*, forcing the latter down against the pressure of springs *D*, so that the hardened jaws *E*, which are attached to these plates, clamp the finished surface *A* on the casting.

As all the cutting tools are carried at one station, the standard turret and the indexing gear are removed and replaced by the circular steel plate *F*. This plate, which is securely fastened to the slide on the machine, is milled out to receive the gear plate *G*, which carries the combination quadrant spiral gear and tool-holder *H*. This quadrant gear meshes with the pinion *I*, gear *H* being pinned to shaft *J* and pinion *I* to shaft *U*. The top plate *L* and a filler block *M* complete the assembly, which is fastened to the plate *F* by means of screws and dowels.



Screw Machine Tools for Performing Multiple Operations, Including the Boring of Two Spherical Seats

The front end *N* of the quadrant gear is slotted to receive the tool bit *P*, which is clamped by set-screws. Another slot in this gear carries the tool bit *Q*, which is clamped in the plate by the set-screw *T*, and is adjusted by screw *R* and lock-nut *S*. The shaft *U* of the pinion *I* projects through the top plate *L* and is pinned to the actuating pinion *W*.

At the bottom of top plate *L* is fastened the bearing *X*, which carries the shaft of the tool-block *Z*, the shaft being held in place by the collar *Y*. The tool-block *Z* is slotted at an angle to receive the forming tool *V*, which is clamped in place by set-screws.

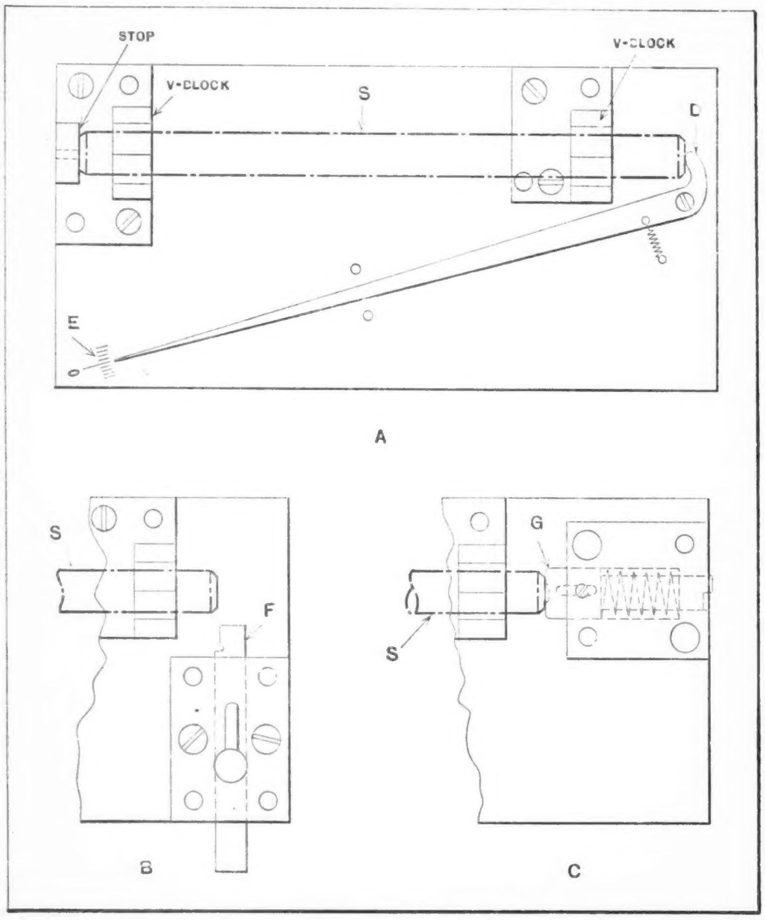
Each machine used for this work was equipped with a standard transfer arm, which was replaced by arms like that shown at *K*. At the top of this arm is fastened a rack, special screws being provided to facilitate adjustment. A stop on the quadrant gear insures that pinion *W* will always return to the correct position to mesh with the rack.

In operation, the work is clamped in the chuck and the turret plate *F* advanced in the usual manner by the cam until the slide reaches the dwelling position, at which time the center of the swiveling tool-holder *H* coincides with the center of the ball seat in the casting. A small cored hole in the center of the ball seat permits the cut to be started at the center.

The auxiliary slide carrying arm *K* is now advanced to the left, the arm being rotated until the adjustable stop-screw in the arm rests on the hardened stop-plate *B* located on the machine. This brings the rack into the position shown, and as the arm continues to advance, the rack meshes with the pinion *W*, causing the latter to rotate with the spiral pinion *I* which, in turn, rotates the quadrant tool carrier *H*.

This action swings the tool through the correct arc to turn the ball seat. The tool *Q* then comes into action and turns the large spherical surface. While the spherical turning tools are in action, the front cross-slide is moved in until the projection *O* engages the button on the tool-block *Z*, causing the block to swing on its shaft and sweep the form tool over the face of the casting to finish both faces as well as the shallow bore. All backlash in both quadrant *H* and swinging tool-block *Z* is taken by coil springs.

New York City B. J. STERN



(A) Indicator Gage for Testing Length of Shaft; (B) Limit Gage Slide Used in Place of Indicator Shown at A; (C) Flush-pin Gage

LENGTH GAGES FOR INTERCHANGEABLE SHAFTS

In the accompanying illustration is shown an indicator gage at *A*, which is used for gaging the over-all length of shafts like the one indicated by dot-and-dash lines at *S*. The shaft is located in V-blocks, with the contact end of the indicator arm *D* pressing against one end. Any variation from the correct length is indicated on the scale at *E*. At *B* is shown the right-hand end of the same gage equipped with a limit gage slide *F*, while at *C* is shown the gage provided with a flush-pin *G*.

Any one of the three gaging methods may be employed successfully, but it is the writer's opinion that the limit gage slide shown at *B* is the most dependable type. Although designed for gaging the length of interchangeable shafts produced in quantities, the principle incorporated in this gage is readily applicable to gages for other kinds of work. S. J. H.

* * *

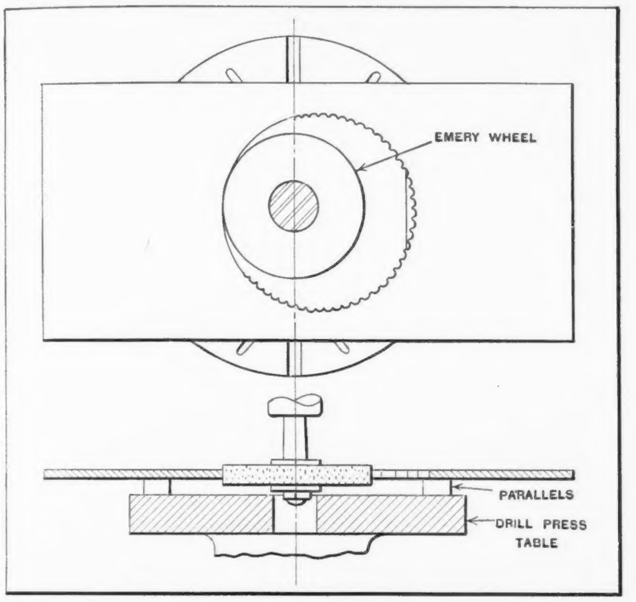
PLANS FOR EXHIBITING PROGRESS IN STEEL PRODUCTION

Eight scientists, known for their achievements in bringing steel to its present degree of excellence, have been appointed by W. H. Eisenman, secretary of the American Society for Steel Treating, to assist him in a study of the most effective means of exhibiting the progress made in steel production during the last hundred years, at the Chicago Century of Progress celebration to be held in 1933. Mr. Eisenman is a member of the National Research Council's Science Advisory Committee, which is collaborating with the Century of Progress trustees in working out a plan for picturing to the public the advances made in pure and applied science during the last hundred years. Mr. Eisenman's associates on the Steel Treating Exhibit Committee are C. B. Murray, who will deal with ores; Arthur G. McKee, blast furnaces; H. M. Boylston, metallurgy, as related to steel making; H. A. Schwartz, casting; Zay Jeffries, non-ferrous substances; C. H. Herty, Jr., open-hearth steel; Mark Lathrop, electric steel; and W. B. Coleman, mechanical aspects of the subject.

Shop and Drafting-room Kinks

GRINDING LARGE HOLES ON A DRILL PRESS

The method usually employed in a small shop for cutting large-diameter holes in boiler plate is to drill a circle of holes and break out the core with a chisel. The filing down of the corrugated edges left by the drilled holes is a long and tedious operation. In order to eliminate this, the writer recently devised a method, shown in the accompanying illustration, for finishing the hole by grinding. The shop drill press is admirably adapted for this work, because the plate can be laid flat on two parallels on the table. The emery wheel is mounted on a holder having a taper shank that fits the machine spindle. By moving the plate around on the parallels, the hole can be ground out to a scribed line with a minimum of effort.



Drill Press Set-up for Grinding Large Holes

H. MOORE
Hamilton, Ont., Canada

MAKING ERASURES AND CHANGES ON VELLUM PAPER

Difficulty is often experienced in making erasures and changes on vellum paper in such a manner that the legibility of the blueprints made from the drawing will not be impaired. When the pressure of either a pen or a hard lead pencil fractures the lower surface of the paper, erasure of the lines will not remove the fractures, and their outlines will be reproduced on the blueprint. A fracture that is caused by folding, or the scratching of the paper by any hard object, also produces the same results. The paper loses its transparency at the fractured points and when a blueprint is made, the lines are reproduced as distinctly as pencil marks.

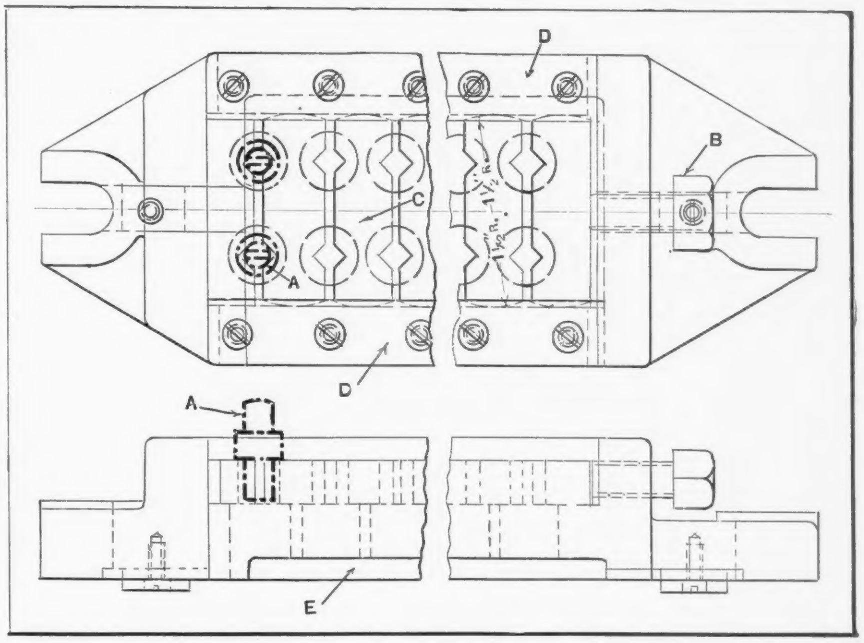
The transparency of the paper can be restored, however, by oiling the back surface. This is done by simply turning the drawing over and rubbing the fractured spots with a small rag saturated with a clean light oil. The oil should be allowed to remain on the paper for a moment, after which the surplus should be removed with a dry cloth.

W. D. T.

MULTIPLE MILLING FIXTURE

In the accompanying illustration, is shown a multiple fixture for use in straddle-milling thirty pieces like the one shown at *A*, in one setting. Fifteen pieces are held in each of two lines. These pieces are of tool steel and are too large to be handled on the screw machine. The pieces are all clamped in place by tightening the hexagonal-head screw *B*. The equalizing blocks *C* are machined to a radius of 1 1/2 inches at their ends and are held in line by two parallel strips *D*. The equalizing action obtained by this construction permits all the pieces to be held firmly in place, regardless of any variations in size. A chip clearance is provided in the cast-iron base at *E*.

Villa Park, Ill. C. W. HINMAN



Multiple Milling Fixture with Equalizing Clamping Blocks

Attachments for Accurate Spherical Turning

Special Devices Designed for Turning Concave and Convex Faces on Cast-iron Laps, Together with Directions for Their Operation

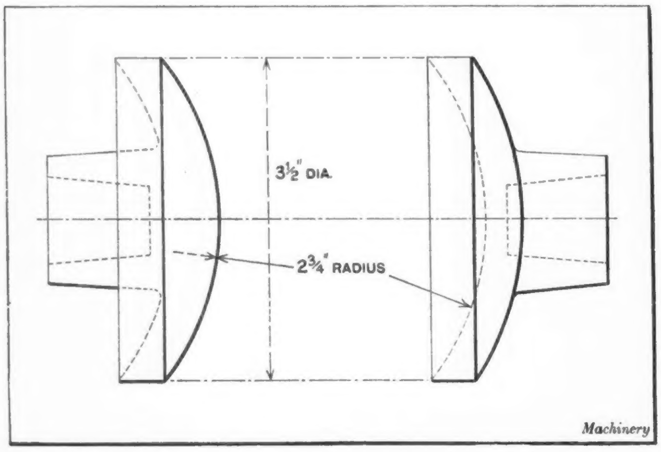


Fig. 1. Cast-iron Laps on which Concave and Convex Surfaces are Machined

TWO useful attachments for turning concave and convex surfaces on the cast-iron laps shown in Fig. 1 are described in this article. All the machining on the work has been done before the final spherical turning is accomplished by means of the special lathe attachments described. For convex laps, this turning is done on an engine lathe equipped with the attachment shown in Fig. 2.

The way the attachment is mounted on the lathe depends, of course, upon the design of the machine; in Fig. 2 the attachment is shown secured to the cross-slide in the position usually occupied by the compound rest. With this attachment, any radius between 2 and 4 inches can be produced. It consists essentially of the base *B*, which is attached to and located on the cross-slide *CS* by the same means as are employed to secure the compound rest. The upper member *S* is pivoted at *P*, and is a close working fit between the base *B* and the retaining plate *RP*. Member *S* carries the adjustable tool-holder *TH*, which, in turn, carries the turning tool *T*. Rotative movement is imparted to member *S* by lever *H*. A stop-plate *SP* limits the movement of member *S*.

An attachment designed along similar lines, for turning the concave surfaces on laps of from 2 to 4 inches radius, is illustrated in Fig. 3. The essential members differ slightly in form, but not in principle, from those of the attachment shown in Fig. 2. The relative positions of the tool-holder and pivot are reversed, and to facilitate machining, the pivot *P* is made integral with the upper member *S*, which is confined by a retaining plate *RP*. The pivot *P* is a good working fit in the lower member *B*, and is held in place by plate *PP*, which is secured by two or three screws, one of which is shown.

The tool-holder is slotted to receive the closely fitting tool *T*. The tool-holder base is tongued, and is a sliding fit in the recess of member *S*; it is clamped in position by the screws indicated. A series of holes is tapped in member *S* to enable the tool-holder to be adjusted for the various radii of the laps. Assuming these holes are 1/2 inch apart, and that the holes in the tool-holder are 3/4 inch apart, adjustments of 1/4 inch are obtained by moving the tool *T* in or out of the holder as required.

The advantage gained by mounting the attachments on the cross-slide lies in the fact that there are facilities for adjusting the attachment transversely and longitudinally; transverse adjustment is necessary, because the pivot *P* of the attachments must be located exactly under the center line of the spindle, and longitudinal adjustment is required for feeding the tool into the cut or withdrawing the whole attachment for tool grinding and resetting.

The construction of the attachments requires a lathe in which the distance from bed to center is at least 7 inches. If a lathe of this capacity is not available or if it is desired to use a smaller one, the attachment can be modified as indicated in Fig. 4. Here it is shown mounted directly on the bed of a lathe in which the distance from bed to center need not be more than 4 to 5 inches.

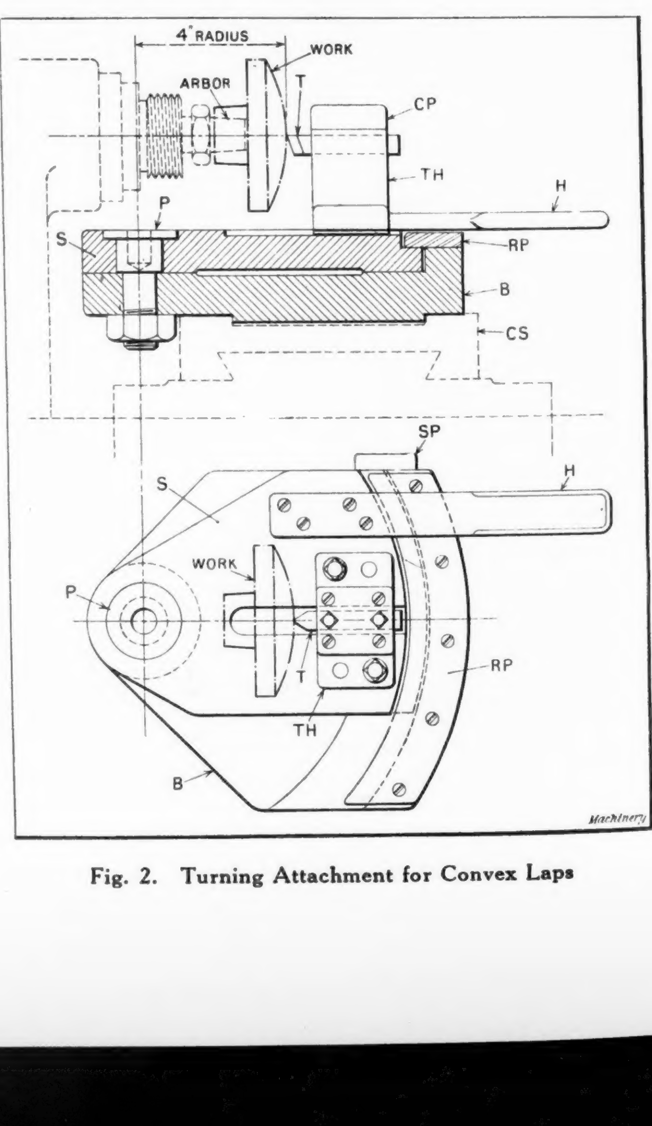


Fig. 2. Turning Attachment for Convex Laps

The method of locating the attachment on the bed is suitable for the ordinary flat-bed type of lathe, where the attachment may be secured by means of a clamping screw *CB* and plate *CP*, as indicated. Adjustment for position and cut is obtained by turning the adjusting screw *AS* in block *AB*. The attachment can be completely withdrawn from the work for grinding and resetting the tool by loosening both clamping screws. The attachment for concave turning, shown in Fig. 3, would be modified along the same lines.

The method of operating the upper member *S* by means of a lever, instead of a rack and pinion or worm and wheel, should give entirely satisfactory results. It will be found advantageous to have two turning operations on the laps—roughing and finishing—between which the laps should be laid aside to season. This procedure will insure accurate work after the finishing operation, and will eliminate much of the tool grinding and resetting necessary in cases where the finishing tools are required to remove scale or uneven surfaces.

Setting up and Operation of Spherical Turning Attachments

The successful operation of these attachments depends essentially upon three adjustments:

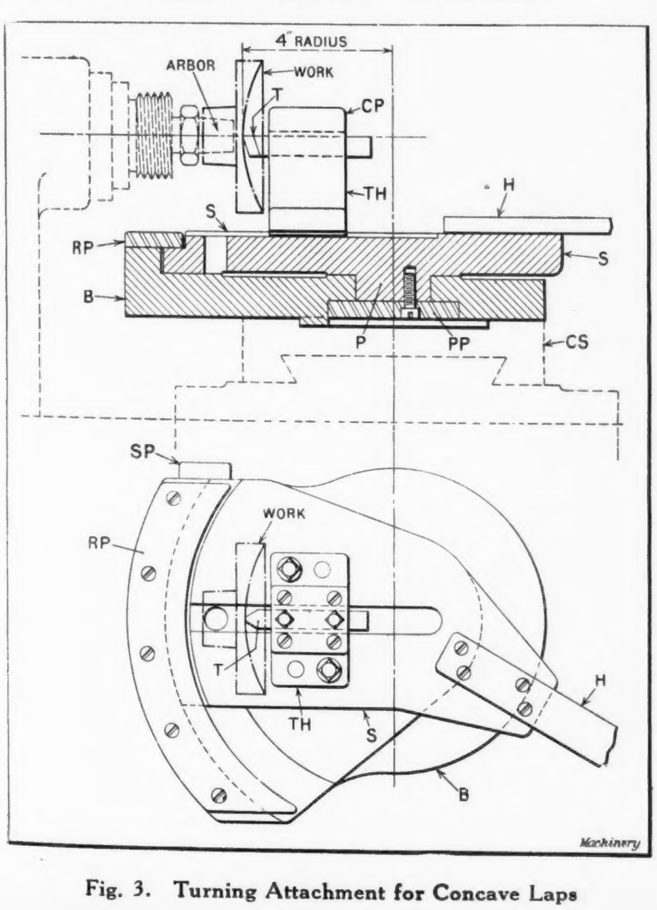


Fig. 3. Turning Attachment for Concave Laps

1. The pivot *P*, Figs. 2 and 3, must be located exactly in the vertical plane through the lathe spindle axis.

2. The tool point must be located away from the center of the pivot a distance equal to the radius to be produced on the work.

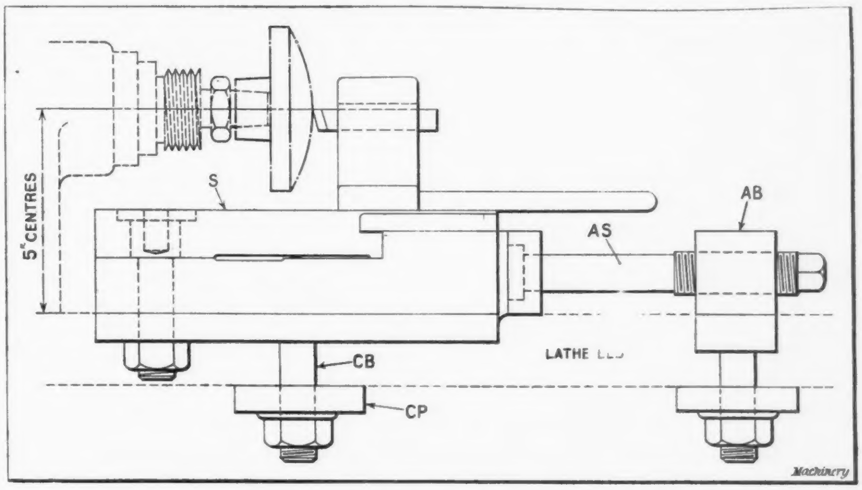


Fig. 4. Turning Attachment Secured Directly on Bed of Lathe

3. The cutting edge of the tool must lie in the horizontal plane through the spindle axis—this is as important in spherical turning as it is in taper turning.

Considering the first-named adjustment, and assuming that the attachment is carried on the cross-slide, as indicated in Figs. 2 and 3, the cross-slide must first be adjusted so that the circular recess used to locate the attachment lies on the center line of the spindle. This is done in the manner indicated in Fig. 5. In the first instance, a plug of known diameter is inserted in the central hole of the recess in the cross-slide, or it may be provided with a base to suit the recess diameter. An indicator is next fastened to the cross-slide by any convenient means, the center of the anvil coinciding with the center of the plug and with the center height of the lathe. The indicator is adjusted to zero, or its reading is taken when it is in contact with the plug, as shown in Diagram 1, Fig. 5. During this stage the cross-slide may be located anywhere across the saddle.

Leaving the indicator securely fixed, the plug is removed. Next, a true running arbor of a diameter equal to that of the plug is placed between the lathe centers, as shown in Diagram 2, Fig. 5. The cross-slide, with the indicator, is next brought up to the arbor and adjusted until zero or the previous reading is obtained upon the indicator, as its anvil comes in contact with the arbor. The recess in the cross-slide is now located exactly on the center line of the spindle. To facilitate future set-ups, it is advisable to drill and ream a hole through the cross-slide into the saddle for a dowel or locking pin.

Having accomplished the preliminary adjustment of the cross-slide, and also doweled or locked it in position, the attachment shown in Fig. 2 is next lightly clamped in approximate position. This is shown in Fig. 6 in the top diagram, and for the

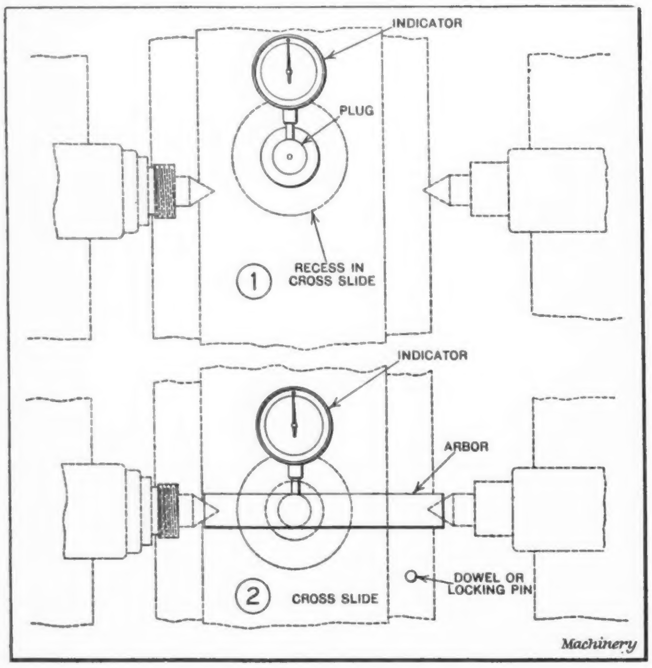


Fig. 5. Method of Centering Cross-slide of Lathe

present purpose the upper member *S* is removed. We have now to adjust the attachment base *B* so that the pivot *P* will be exactly on the center line of the spindle. The means employed in doing this are similar to those described in connection with Fig. 5.

In this instance, the arbor is first placed between the lathe centers; the indicator is attached to any convenient part of the lathe, and is adjusted on its post to the correct center height. It is then brought into contact with the arbor, set to zero, or its reading taken. The arbor is next removed, and a plug of the same diameter is inserted in the center hole of the pivot. The base *B* is now turned so that the center of the plug will come in contact with the anvil of the indicator. The pivot *P* will exactly coincide with the center line of the spindle when the indicator is at zero, or at the previous reading, as indicated in the lower view, Fig. 6. The base *B* is now clamped in position on the cross-slide, and to facilitate future set-ups a hole is drilled and reamed through the base and into the cross-slide to receive a dowel or locking pin.

Assuming the preliminary setting and locking of the cross-slide has been carried out in accordance with the diagrams, Fig. 5, the lathe is set to receive the concave attachment, Fig. 3; also, in this case, the pivot *P* is concentric with the rabbet which fits the recess in the cross-slide, so that the adjustment shown in Fig. 6 is not required.

The actual setting up and operation of the attachments will now be described. Dealing, in the first instance, with the turning of the convex lap, as shown in Fig. 2, it will be seen that the work is mounted on an arbor tapered to suit the hole in the work. On the completion of the operation, the work is removed by loosening the nut indicated. When the attachment is mounted on the cross-slide, both are located in position by the locking pins indicated in Figs. 5 and 6.

We have now to deal with the adjustment of the tool point to give the required radius on the work. Referring to the upper diagram, Fig. 7, it is assumed a 4-inch radius is required. The toolpost is set and clamped in a convenient position on the upper member *S*. The tool is inserted in the slot in the tool-holder. A plug, as shown, is located on the pivot. If the diameter of the plug is 1 inch, a 3 1/2-inch setting gage applied as shown will insure that the tool point will be located a distance of 4 inches, as required, from the center of the pivot. Another type of gage, somewhat more convenient to handle is also shown. It will be noted that a series of standard setting gages is all that is required for setting the tool point to produce the desired radius.

The method of setting the concave turning tool is indicated in the lower diagram, Fig. 7. In this case, it is not practicable to use a plug coincident with the pivot *P*. A hole is made in the slide *S* to suit the plug, and at a known distance from the center of the pivot, in this instance, 4 3/4 inches. In order, then, to set the tool to produce a radius of 4 inches, a setting gage 1/4 inch thick will be used between the plug and the tool point as shown. The tool-holder is accurately finished to take a closely fitting tool, ground all over to insure a good fit and exact center height. All grinding operations are performed on the end of the tool.

The attachment and tool having been set up and adjusted, the saddle may be moved up to the work and a trial cut taken, beginning at the outer diameter. The stop-plate should allow the tool point to travel slightly beyond the center of the work. Another cut may be taken if desired after a slight forward movement of the saddle. On no account must the tool itself be moved relative to the holder or upper member *S*.

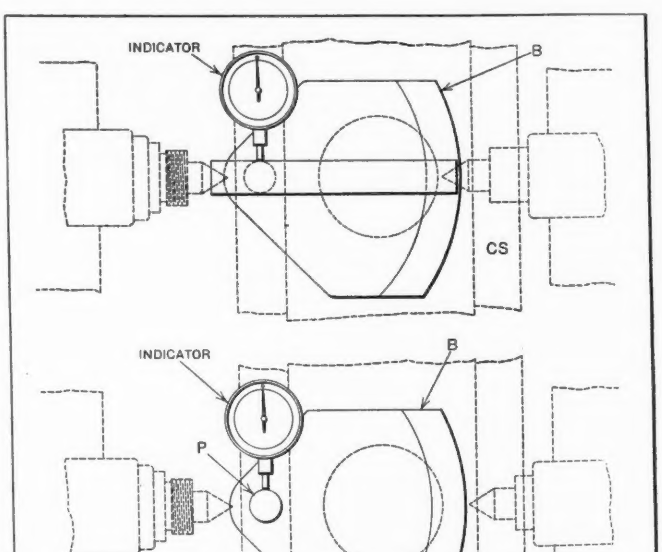


Fig. 6. Method of Locating Attachment Pivot on Center Line of Lathe Spindle

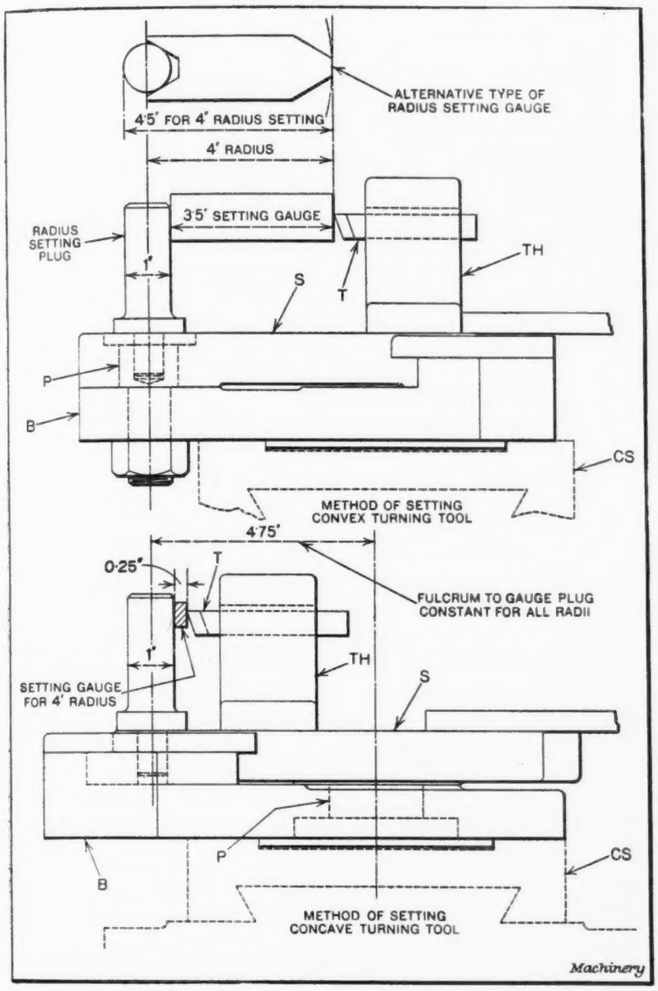


Fig. 7. Setting Tools for Required Radii

These attachments are useful principally for returning worn laps. For this purpose they will be found to be rapid and simple in operation.

* * *

SECOND WORLD POWER CONFERENCE

The second World Power Conference will be held in Berlin, Germany, June 16 to 25, 1930. The first World Power Conference was held in London, England in 1924, and in October and November of this year a sectional meeting was held in Tokyo, Japan. These conferences enable those interested throughout the world in the generation and distribution of power to meet together and discuss recent developments and experiences.

The main theme of the 1930 conference will be the development of power supply and power utilization. Among the subjects to be considered are new fields for the application of power; efficient utilization of generating plants and distribution networks; storage of power; interconnection of different power-producing plants; large central plants; reduction in costs of construction; tariff systems; administration and legislation; and safety measures. More than 200 papers will be presented. These papers will not be read, but will be distributed in printed form to all participants some time before the sessions begin. It is expected that forty-seven different countries will be represented. An arrangement has been worked out by means of which every address can be heard in the three official languages—German, English, and French.

Several important social events have been planned for the time not occupied by the sessions, and visits will be made to various important industrial works in Germany. The managing offices of the conference are at Ingenieurhaus, Berlin N. W. 7, Friedrich Ebertstrasse 27. American participants can obtain further information from O. C. Merrill, general chairman, American National Committee, World Power Conference, Federal Power Commission, Washington, D. C.

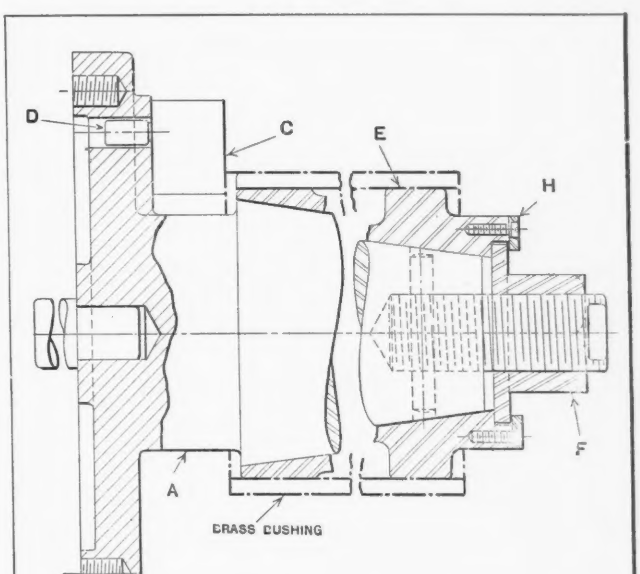
* * *

EXPANSION ARBOR WITH REMOVABLE STOP

By J. E. FENNO

Great accuracy is required in turning the outside diameter and squaring up the ends of the brass bearing bushing shown in heavy dot-and-dash lines in the accompanying illustration. The faceplate arbor shown was made to meet these requirements. The bushing, which was previously rough-machined to within 1/64 inch of the finish size, is slipped on the split sleeve *E* until it comes against the stop *C*. The nut *F* is then tightened, expanding the split sleeve on the tapered portion of member *A*, and thus holding the bushing securely.

The stop *C* has a shank *D* which fits loosely in a hole in the member *A*, to facilitate handling while securing the bushing on the arbor. When the bushing has been put in place, the stop *C* is swung around until it clears the bushing, and is then removed to allow the inside squaring tool to clear. This stop insures the same setting for each bushing. The outside diameter is finish-turned and both ends are squared without removing the work from the arbor, thus insuring the required accuracy.

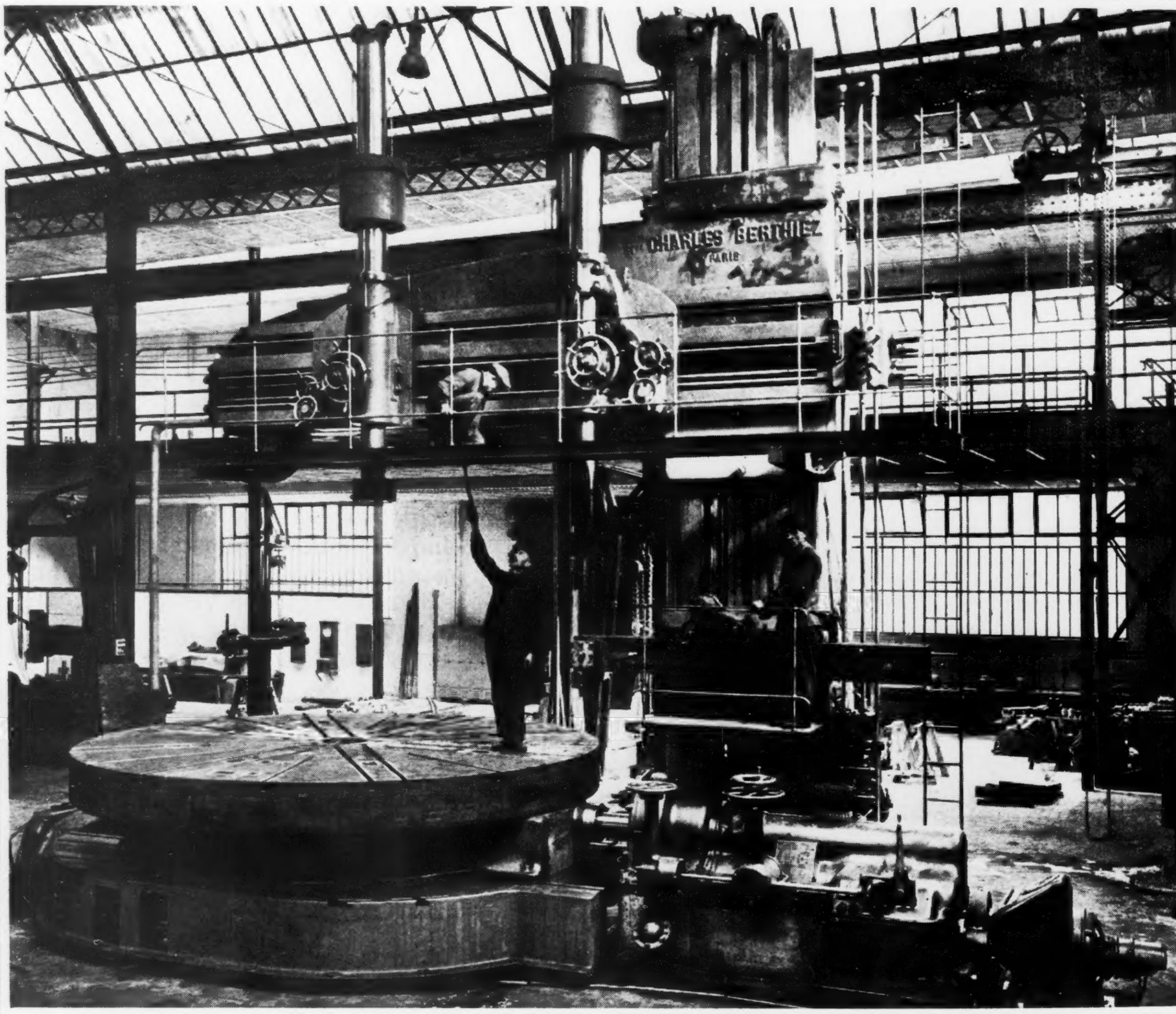


Expansion Arbor having a Removable Stop for Setting all Bushings to be Machined, in the Same Position

Large Boring and Turning Machine

Special Single-upright Design having Table that can be Adjusted for Turning Diameters Exceeding the Normal Capacity

A SINGLE-UPRIGHT boring and turning mill recently built in the shops of Charles Berthiez, 44 Rue Lafayette, Paris (IX^e), France, is said to be the largest mill of single-upright design that has ever been constructed. This machine, as shown in the accompanying illustration, is equipped with a special patented feature in the form of an adjustable table for increasing the capacity. The maximum normal diameter that can be turned is 23 feet, but by locating the table farther from the upright column, a diameter of 35 feet can be turned. This table adjustment is parallel to the arm of the machine, so that the center of work can be reached up to the maximum range of the tool-slide, which is an advantage over machines requiring a backward adjustment of two uprights.



Single-upright Type of Boring and Turning Mill with Normal Capacity of 23 Feet and a Table Adjustment for Work up to 35 Feet in Diameter

The maximum height that can be turned is 14 feet, and the machine will turn parts weighing as much as 85 tons. The weight of the machine itself is 120 tons, and the weight of the largest part of the machine, 45 tons. The electrical equipment consists of five motors, all controlled from a central switchboard as well as from other points convenient to the operator. In addition to the motor for the main drive, a second motor is furnished for lifting and lowering the arm that supports the tool-slides, a third motor for the quick adjustment of the three tool-slides (two vertical slides and one horizontal slide), a fourth motor for the rapid adjustment of the table, and a fifth motor for driving the lubricating pump. These motors have a total capacity of 120 horsepower.

Standard Spur Gear Tooth Forms

Why Four Different Standards Have Been Adopted, Their Advantages, and Relation to Previous Standards

By H. J. EBERHARDT, Chairman, Tooth Form Committee
American Gear Manufacturers' Association

THE Tooth Form Committee of the American Society of Mechanical Engineers and the American Gear Manufacturers' Association have proposed and adopted four standards for spur gears. These standards are as follows:

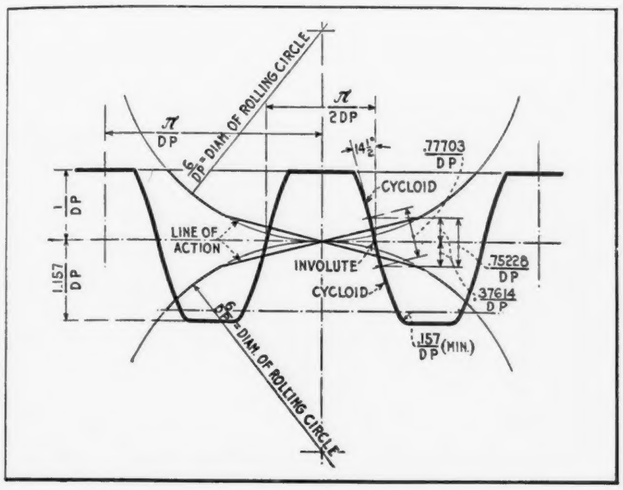


Fig. 1. Basic Rack for 14 1/2-degree Composite System—Full-depth Tooth

1. 14 1/2-degree full-depth tooth and composite form of basic rack.
2. 20-degree stub tooth system.
3. 14 1/2-degree full-depth tooth and straight-sided basic rack.
4. 20-degree full-depth tooth and straight-sided basic rack.

As pamphlets and articles relating to these standards have been published, their important characteristics are quite generally known, especially among gear designers and users of gearing in the machine-building industry. But the reasons underlying the adoption of these standards and their relationship to older standards, as well as their practical advantages, are not so generally understood. The kind of information that doubtless would be of interest is indicated by a series of pointed questions received from a professor of machine design in one of the large universities. These questions follow, and the answers have been placed beneath each respective question for the convenience of the reader.

1. Is the 14 1/2-degree composite system (see Fig. 1) the same as the old Brown & Sharpe standard full-depth tooth? The proportions check with available data on the Brown & Sharpe system, which indicates that the two systems are the same and therefore interchangeable. Is this correct?

The composite system is substantially the basis of the old well-known Brown & Sharpe system for interchangeable gears. Basic racks of both systems are the same. Brown & Sharpe cutters, however, provide for a certain amount of tip relief, which is not included in the composite standard. Nevertheless, gears made to this system will interchange with gears cut with Brown & Sharpe system cutters. It should be made clear that while the 14 1/2-degree composite system has the same basic rack as the Brown & Sharpe full-depth system, *systems* and *workmanship* are decidedly different factors. It is not correct, therefore, to say that this system will produce Brown & Sharpe gears, unless it is used by the Brown & Sharpe Mfg. Co., Providence, R. I. The systems, however, are interchangeable.

2. Are the dimensions (shown in Fig. 2) for locating the cycloidal parts of the tooth profile those actually used in the construction of the cutters for producing these gear teeth? This is assumed to be the case, due to the difficulty of constructing the true cycloidal curve.

The approximation to the basic rack, Fig. 2, is recommended for the construction of cutters for this system. The assumption that it is difficult to construct the true cycloid is correct. This basic rack is also conjugated from disk cutters bought in the open market, of various manufacturers. In these cases, the generating rack contains the feature of tip relief or ease-off previously mentioned, and strictly speaking, eight basic racks would have to be generated to produce curves such as are obtained by the eight cutters in the usual set of disk cutters. This matter of ease-off is being considered by the tooth form committees.

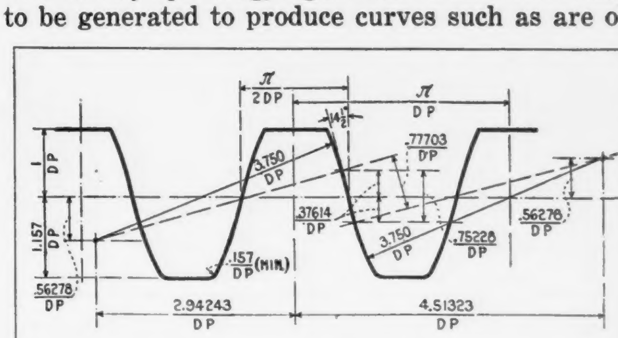


Fig. 2. Approximation to Basic Rack for 14 1/2-degree Composite System—Full-depth Tooth

3. Is the new 20-degree stub involute system to replace the present Fellows 20-degree stub system?

The stub tooth system is superseding the nine previous stub tooth systems which have been in use in this country. This standard stub system, we are informed, is not superseding installations of the Fellows system, but for new or future design

it is recommended practice, as the various pitches are in proportion to one another, which is not the case in the Fellows system. The Fellows Gear Shaper Co. has cooperated with the tooth form committees, their chief engineer, E. W. Miller, being one of the members of those committees.

4. A note published in connection with the 20-degree stub involute system refers to the interchangeability of the Nuttall system with the 20-degree stub system. Are there other systems that are interchangeable with any of these new systems?

The Nuttall system and a few of the pitches of the Fellows system will interchange with the new system. The only differences are in the clearance areas between the tip and bottoms of the mating teeth. We do not know of any other systems that are interchangeable in this respect. The committees have not proposed any brand new systems, having preferred to define and recommend systems now in successful use.

5. Does the Tooth Form Committee have any general recommendations for guiding the designer in choosing one or the other of the proposed systems?

In general, we would recommend the composite system for those concerns that have been using the Brown & Sharpe form for many years, as this will make the repair problem much simpler, and the system is a very good one. The Research Committee of the American Society of Mechanical Engineers reports that, of several kinds of gears, those made to the Brown & Sharpe system prove the quietest. This is believed to be due to the long line of action of the composite system, and also, possibly, to the presence of tip relief. Tip relief is being considered by many engineers now, and as gear mountings improve, tip relief is made less or omitted altogether, with good results.

The full-depth tooth, 14 1/2-degree straight-sided basic rack is recommended and used for new designs, where a straight-sided basic rack generating cutter is of advantage, due to the straight-line simplicity and also to the ease with which a long addendum pinion can be calculated for the purpose of avoiding under-cut. The line of action of 14 1/2 degrees is longer than that of the 20-degree involute and contains more teeth in action; hence, the tendency is for the gear to run more quietly.

The full-depth tooth, 20-degree straight-sided basic rack is recommended and used for the same reasons as the full-depth 14 1/2-degree straight-sided form, and also where a stronger tooth is desired. What is substantially the 20-degree full-depth involute system has been adopted as the sole standard by Germany. It would be an ideal theoretical state of affairs if we would agree on one standard for this country, but at the present time too many conflicting interests oppose this ideal condition, and with good reasons, as we are by far the largest producers of machinery, and an enormous quantity of gears are now running made to the various systems.

6. Does your committee contemplate recommending any other standards for straight spur gear forms or are the present standards intended to cover all straight spur gear requirements?

The committee does not contemplate recommending any other standards in this field, as many members of the committee wish that one standard would do for all purposes.

7. According to a note in connection with the standard 14 1/2-degree composite system, "the term diametral pitch is used up to 1 D. P., inclusive, and the term circular pitch is used for 3 inches C. P. and over." This permits a slight overlapping, as a 1 D. P. has a circular pitch over 3 inches (3.1416 inches). Which part of the note is intended to apply between 3 inches and 3.1416 inches?

Mathematically, the diametral pitch and circular pitch values overlap. In the actual use of these standards, however, as practiced, diametral pitches of the standard sizes are used up to 1 D. P., and circular pitches of the standard sizes are used from 3 inches up. For example, 3 1/8-inch circular pitch would be used in preference to a fractional diametral pitch less than unity; and 4-inch circular pitch would be used in preference to a pitch in the neighborhood of 3/4 diametral pitch. It will be recalled that this standard refers to spur gears. Worm-gearing down to the very fine pitches is still popularly made to circular pitch.

* * *

WESTINGHOUSE PENSION SYSTEM

Employes of the Westinghouse Electric & Mfg. Co. who retire at the age of sixty-five years or over will be guaranteed substantial incomes for the remainder of their lives as the result of the institution of a new annuity payment plan. The plan will affect practically all of the 50,000 workers on the Westinghouse payroll. Under its provisions, an employe will not only receive an earned reward for length of service, but will also be given an opportunity to buy additional retirement income for himself at a favorable rate. Employes will be encouraged but not obliged to participate in the plan.

The company's part of the cost of the plan will be paid as a regular operating expense, just as wages and repair costs are paid. At the expiration of every year of service, the employe will receive an annuity certificate entitling him to a number of units of income after retirement, depending on his salary. The net annual cost of the plan to the company is estimated to be 1.2 per cent of the payroll. The company's part of the plan will be operated under a deed of trust administered by a board of trustees, with a bank acting as custodian of the funds. The board is composed of F. A. Merrick, president of the Westinghouse Electric & Mfg. Co.; J. D. Callery, a director of the company and president of the Diamond National Bank; T. P. Gaylord, J. C. Bennett, and J. W. Thompson, vice-presidents of the company. The employes' part of the plan will be underwritten by the Equitable Life Assurance Society of the United States.

MACHINERY'S DATA SHEETS 167 and 168

MACHINERY'S DATA SHEET INDEX—I

January, 1923, to November, 1929, Inclusive

MACHINERY'S Data Sheet No. 167, New Series, December, 1929

MACHINERY'S DATA SHEET INDEX—II

January, 1923, to November, 1929, Inclusive

MACHINERY'S Data Sheet No. 168, New Series, December, 1929

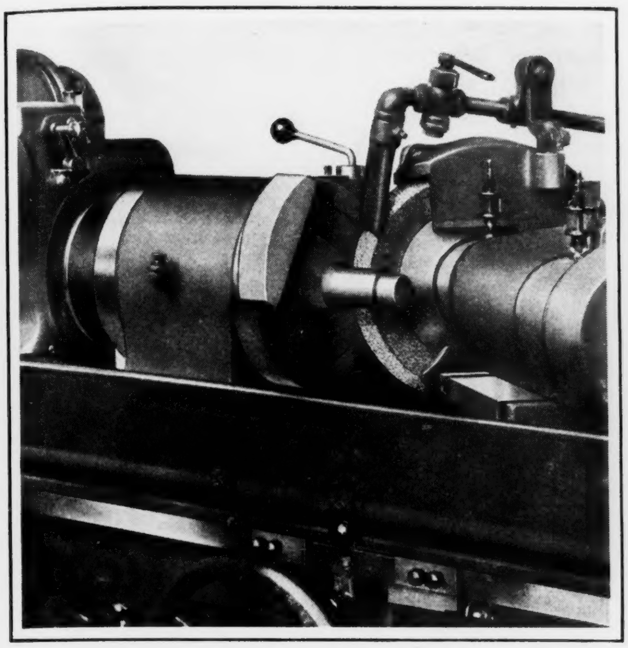


Fig. 1. Grinding the Pin of a Two-piece Airplane Crankshaft, Using Special Work-holding Fixtures

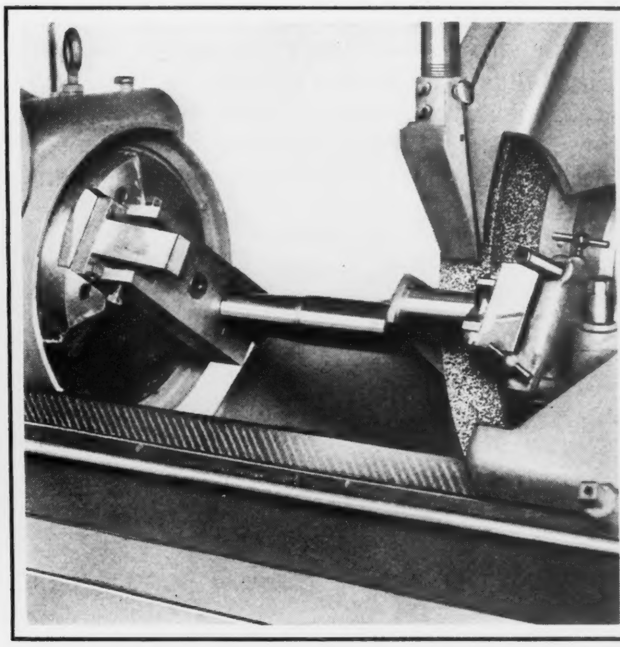


Fig. 2. Grinding the Line Bearings and Crankpins of a Single-throw Crankshaft for Airplane Engines

Precision Grinding in the Airplane Industry

Examples of Crankshaft Grinding, Duplex Wheel Grinding Applied to Camshafts and Cylinders, and Centerless Grinding

By JOHN M. KRINGS

THE advance of the airplane industry has brought with it many new developments in machine tools. Manufacturers of machinery have put forth a special effort to enable builders of airplane engines to put the manufacture of their products on a production basis, to lower production costs, and to make it possible to machine component parts to the finest limits of accuracy.

Many interesting developments are being contributed by grinding machine manufacturers, and the market that has been opened up by builders of airplane engines has prompted the design of unique fixtures and machines to handle this special work efficiently. Most of the engineering developments have consisted in adapting standard machines for this work by the use of new fixtures rather than designing entirely new machines. Special equipment instead of special machinery has been worked out to advantage on account of flexibility and accuracy.

Equipment for Crankshaft Grinding Operations

Various new developments along these lines have been worked out by Cincinnati Grinders Inc., Cincinnati, Ohio. In Fig. 1 is shown an interesting application of a Cincinnati 16- by 36-inch universal self-contained grinder for accurately finishing the pin diameter of a two-piece airplane crankshaft. On this particular crankshaft, the counterweights are forged integral, making it necessary to grind the pin diameter with the wheel applied at an angle of approximately 45 degrees as shown.

The special fixture for holding and rotating the work is mounted on the table of this universal grinder and is bored eccentrically, so as to hold the crankpin in correct relationship with the journals. The work-head for driving this drum-type auxiliary live spindle work-head is of an improved design, with a speed range of 9 to 1 incorporated as standard. A variable-speed direct-current motor with a speed range of 3 to 1 is used, and the 9 to 1 range is obtained by transmitting the drive through back-gearing, controlled by a small hand-lever. The motor transmits power to the worm-shaft through a silent chain drive. On this head it is easy to transfer the drive from the live to the dead spindle. This change is made by the quick adjustment of a key which slides in a slot on the rear of the faceplate.

Figs. 2 and 3 show additional special work-holding and driving fixtures which are being employed for grinding airplane engine crankshafts. Fig. 2 shows a simple arrangement on a Cincinnati 16- by 36-inch plain self-contained grinding machine for grinding the line bearings and crankpins of a single-throw crankshaft. Fixed throw blocks are used. To compensate for the unbalanced condition of the crankshaft while in the fixture, the

faceplate is equipped with balancing weights, which insures a smooth and steady rotation of the work.

Fig. 3 illustrates a more elaborate fixture known as a "cradle" type, which is adjustable for varying throws. The cradle-type throw block does not put the crankshaft under compression during grinding.

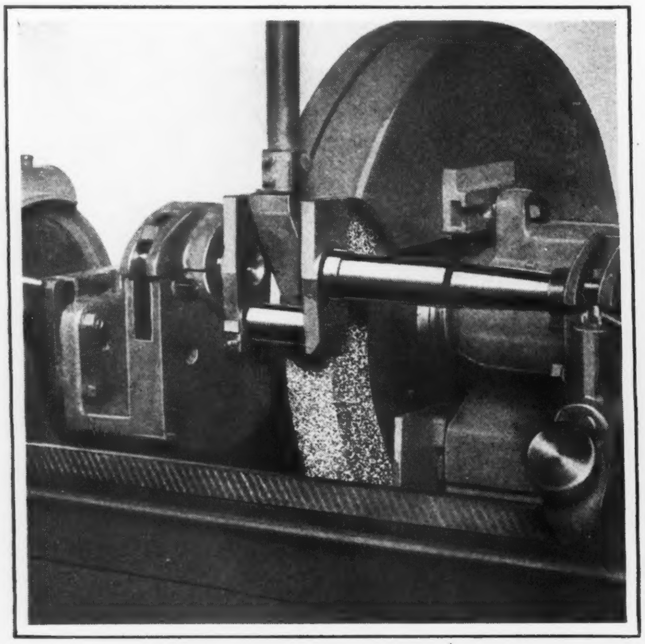


Fig. 3. More Elaborate Fixture than that Shown in Fig. 2, known as the "Cradle" Type, which is Adjustable for Varying Throws

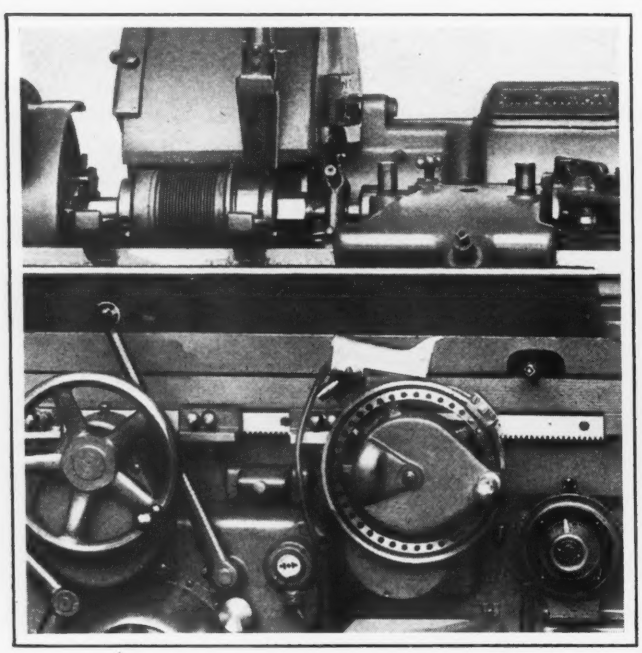


Fig. 5. Grinding the Diameter and Flange Face of a Cylinder on a Plunge-cut Grinder with Automatic Sizing Device

Swinging and readily clamped caps are furnished for head and footstock fixtures, so arranged as to facilitate loading and unloading the crankshaft. For varying diameters of work, adapter bushings are used. Location is taken from a keyway on the line bearings, and positioning is obtained by a plunger bracket mounted on the table.

Examples of Duplex-wheel Grinding

Another interesting application of economical grinding in the airplane industry is the finishing of two diameters of water-cooled aircraft engine camshafts at one grinding operation, as illustrated in Fig. 4. This job is being handled on a Cincin-

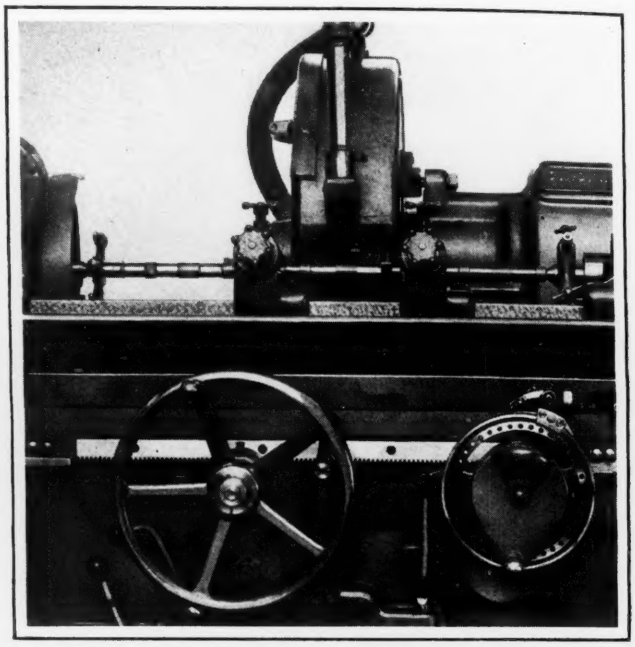


Fig. 4. Finishing Two Diameters of a Camshaft Simultaneously by Using Two Properly Spaced Grinding Wheels

Fig. 6. Grinding the Seats and Adjacent Faces on a Cylinder Barrel which is Mounted on a Special Mandrel

nati 14- by 36-inch plain self-contained grinder with a duplex wheel arrangement. The two steady-rests shown provide ample rigidity to give the desired production. The duplex wheel arrangement cuts the grinding time in half, and the work loses nothing in the way of accuracy or high finish.

A Cincinnati 14- by 18-inch plunge-cut grinder, installed for grinding the diameter and flange face of airplane engine cylinders, is designed to carry multiple wheels so that two diameters can be ground simultaneously. (See detail view of grinding operation, Fig. 5.) On this particular job, the work can be ground twice as fast as formerly. The machine is a standard plunge-cut grinder, with an automatic electric sizing device for the grinding wheel in-feed, and a lever-operated tailstock with cam lock for the footstock barrel. A treadle is provided on the front of the machine to start and stop the work, leaving the operator's hands free for loading and unloading. Loading cradles have also been provided to facilitate placing the work in the machine and removing it when completed.

Fig. 7. Grinding Piston-pins on a Centerless Grinder Utilizing a Gravity Feed Chute

Fig. 6 illustrates a Cincinnati 12- by 36-inch universal grinding machine grinding the seats and adjacent faces on cylinder barrels. This machine has a single wheel. The cylinder barrels are mounted on a special mandrel and are quickly ground to close limits. High production was not essential on this job, and consequently this toolroom grinder was well adapted for grinding these parts.

Examples of Centerless Grinding

Piston-pins, valve guide bushings, rollers, and many other miscellaneous parts for airplane engines are being successfully ground at a high rate of production on Cincinnati centerless grinders. Fig. 7 shows a No. 2 centerless grinder in operation. On this machine piston-pins are being ground by the through-feed method. The operator places the pins in a gravity chute as the illustration shows, from which they pass continuously between the grinding wheel and the regulating wheel. There is no loss of time and the machine is operating at maximum efficiency. The ease with which accuracy is obtained on centerless grinders makes it practical to hold the limits very close on work of this nature.

The application of a centerless grinder for grinding the valve push-rods for an airplane engine is shown in Fig. 8. On these rods, the "in feed" method of grinding is used. This method is employed because the end diameters of these rods are finished, whereas the body diameter is left unfinished. A slight chamfer is ground on both ends, and this is accomplished by feeding the work between the wheels up to an end stop, the wheels being profiled to give the desired angle and shape of the chamfer. On this job an outboard roller infeed work-rest is used. By setting the regulating wheel housing to an angle of 1 degree, the work

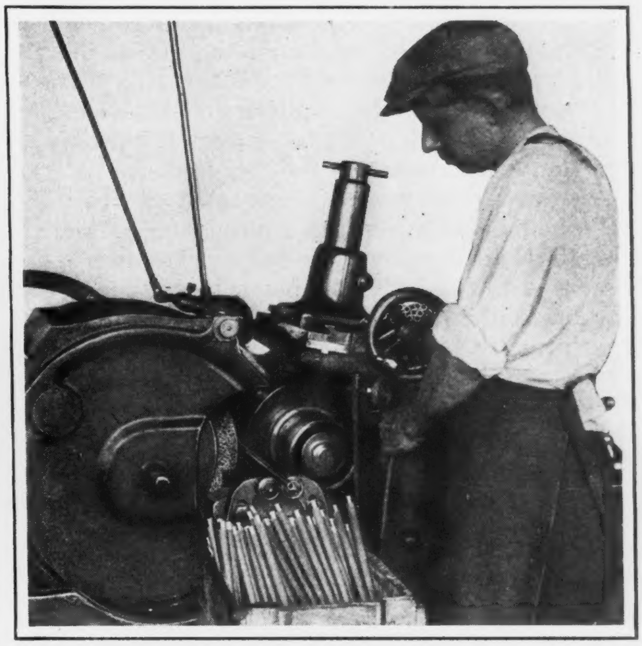


Fig. 8. Grinding the Ends of Valve Push-rods by the "In Feed" Method on a Centerless Grinder

is kept up against the end stop. Sizing is accomplished by the regular "in feed" method of grinding.

* * *

HUGE STEAM DROP-HAMMER

A huge steam drop-hammer has been built for installation at the Milan Works of the Fiat Co. in Italy by the Chambersburg Engineering Co., Chambersburg, Pa. This hammer is of the standard Chambersburg design, but its dimensions are considerably out of the ordinary. It has a falling weight of 24,000 pounds with a cylinder bore of 32 inches and a stroke of 52 inches. The steam line is 7 inches in diameter, and the exhaust 9 inches. The ram from front to back measures 66 inches, and the distance between the guides is 42 inches. The over-all height of the hammer from the bottom of its three-piece anvil to the top of the head is 34 feet 10 inches. From the floor line it is 24 feet 4 1/2 inches. The anvil is made in three sections to facilitate shipping, and has a total weight of 482,000 pounds. The weight of the complete hammer is 662,000 pounds.

Special Tools and Devices for Railway Shops

Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-saving Devices

RADIUS-TURNING FIXTURE FOR LATHE

By E. A. LOTZ, Shop Foreman, Pennsylvania Railroad Co.

The radius-turning fixture shown diagrammatically in Fig. 1 was designed and built at the Altoona Works of the Pennsylvania Railroad, where it is now in use. It is employed on an engine lathe for turning radial bushings of the kind shown by the heavy dot-and-dash lines at *A*. The adoption of this fixture effected a saving of 75 per cent in the labor costs by replacing the old method of using the hand feeds to form or turn the work to fit a radius gage. In addition to the saving in machining costs, the fixture makes it possible to turn the work to exactly the required radius.

The part to be turned is mounted on the mandrel *S* held between centers, a lathe dog, not shown, being used to complete the drive. The bracket *B* is secured to the lathe as shown in Figs. 1 and 2. This bracket is so positioned that the pin *C* is located directly below the center of the part to be radius-turned. A center line is scribed at *X* on bracket *B*, from which measurements can be taken to the sides or faces of the work to insure accuracy in setting the bracket. The arm *D* on which the cutter *E* is located swivels about pin *C* when the lathe carriage is fed in either direction. This movement results in taking a radius-turning cut on the work.

The cutter *E* is held in a V-shaped bearing block *F*, Fig. 2, having a transverse adjustment which permits a variation of about 3 inches in the diameter turned. The cutter is held securely in place by means of a screw *H* which passes through a slidable block *G*, shown in a separate view to the right in Fig. 2.

The swiveling action is transmitted to arm *D* by the pin *J* fitted with a hardened bushing which is a sliding fit in the slot *K*. The plate *L*, on which stud *J* is mounted, is secured to the lathe carriage by means of the T-shaped piece *M* and the screw *N*. Two dowel-pins *O* serve to hold plate *L* in place.

HOBBING THE TEETH IN LOCOMOTIVE THROTTLE LEVER QUADRANTS

By H. H. HENSON, Foreman, Machine and Erecting Shop, Southern Railway Co.

The cost of producing the teeth in locomotive throttle and reverse-lever quadrants has been greatly lessened by employing the set-up shown in the accompanying illustration, in which the gear-hobbing principle is employed. The base *A* of the

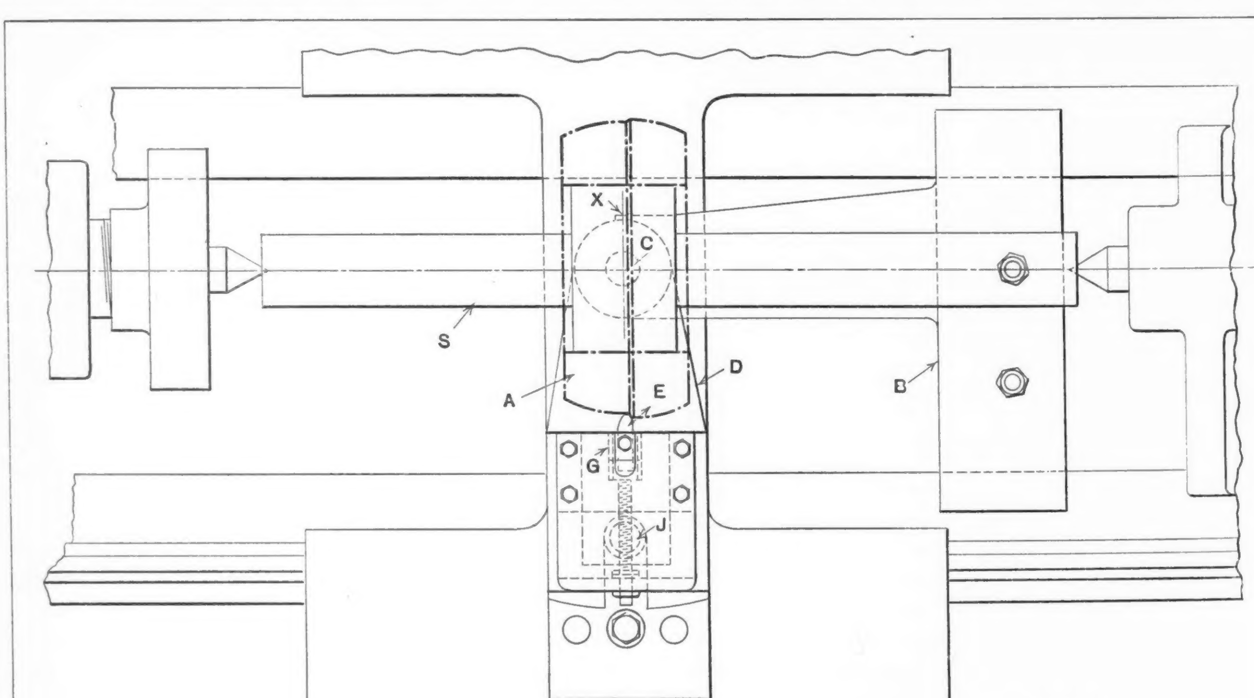


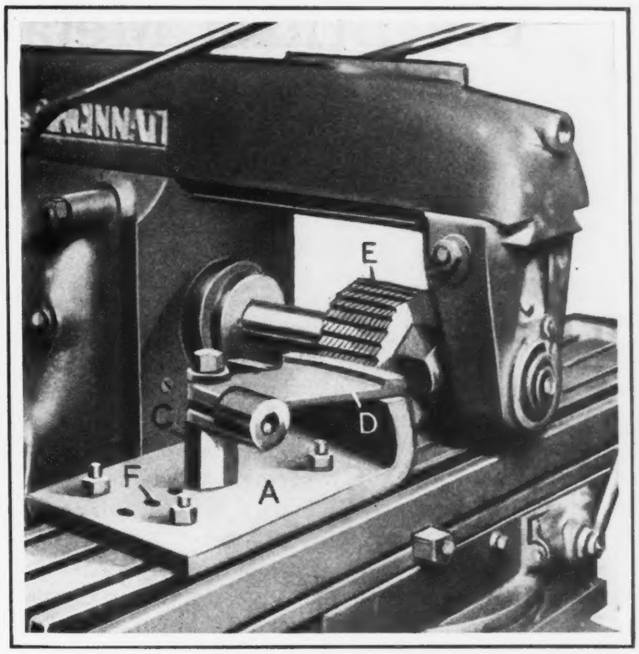
Fig. 1. Diagram Showing Arrangement of Radius-turning Fixture

fixture has an adjustable stud C on which the quadrant or work D is so mounted that it can be easily revolved. It will be noted that the portion of the work on which the teeth are cut is well supported by the leg of the fixture.

The hob E used for cutting the teeth is of the type employed for spur gear hobbing. The face widths of the quadrants usually range from 3/4 to 1 inch, and the teeth are cut by one passage of the hob. The fixture is tilted to the same angle as the helix angle of the hob teeth, so that the cutting sides of the teeth are aligned with the axis of the quadrant. This results in cutting straight or rack-shaped teeth.

In cutting the teeth in a quadrant, the milling machine table is advanced until the cutter spots the work. The micrometer thimble on the lead-screw is then used as a guide in feeding the table in to give the required tooth depth. The cutting action of the hob revolves or feeds the quadrant around, completing the teeth at one pass of the work. This operation is ordinarily completed in five minutes.

The quadrants usually have four or five teeth per inch. The base of the fixture A has several holes F in it, which permit the position of stud C to be changed in order to accommodate quadrants of different sizes. The hobs used are about 5 inches in diameter and 5 inches long. They are made of tool steel, and are hardened and tempered.



Hobbing Teeth in Locomotive Throttle Lever Quadrants

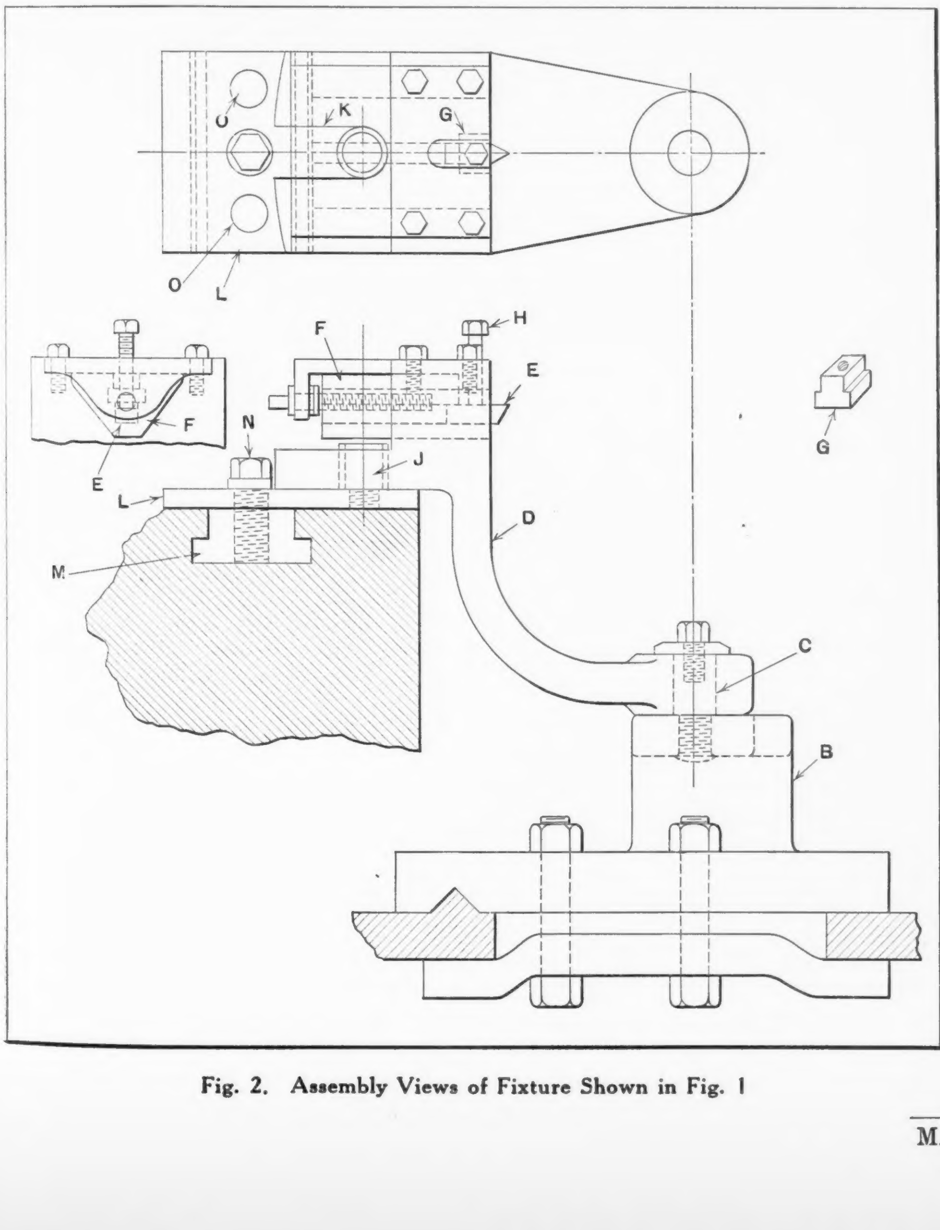


Fig. 2. Assembly Views of Fixture Shown in Fig. 1

* * *

A magneto compass, produced by the General Electric Co., has been installed in one of the large tri-motored airplanes which ply between Chicago and San Francisco. It is the first application of this type of compass to air transport service, and is being tested for its value on long day and night flights through clear and foggy weather. It is a remote indicating device, and its chief advantages result from the use of pole pieces. These give the directional effect and, at the same time, concentrate the lines of force of the earth's magnetic field, thereby producing a denser field in which to operate. The older types of remote indicating compasses involve the use of comparatively large rotating armatures with a large number of turns; the armature in the magneto compass is about the size of a walnut, with but a few turns. The average complete installation weighs approximately 12 pounds.

The British Metal-working Industries

Conditions in Machine Tool Field Highly Satisfactory—Extensive Plans Being Made for Railway Development

From MACHINERY's Special Correspondent

London, November 18, 1929

THE satisfactory position in the machine tool industry that has prevailed almost without interruption during the last twelve months, is in marked distinction to the conditions obtaining in industry as a whole. Reports from machine tool makers that they are working over-time to keep pace with orders are becoming commonplace, and it is difficult to point to any type of machine that is not in fairly good demand. It may be mentioned, however, that many firms have noted an increase in the proportion of standard to special machine tools during recent months.

Overseas Trade in Machine Tools Shows Slight Decline

Exports of machine tools in September showed a falling off in both tonnage and value, compared with the preceding months. Thus 1137 tons valued at £150,615 were exported during September, as compared with 1437 tons valued at £200,693 in August and 1228 tons valued at £174,031 in July. The ton value of exports also fell from £140 in August to £132 in September. So far as exports are concerned, every month this year up to September has been above the monthly average of last year, although March, June, and September were just on the right side.

Imports also showed a decline in September, 839 tons valued at £153,807 having been imported, as against 998 tons valued at £196,362 in August, and 833 tons valued at £171,483 in July. The ton value of imports which stood at £206 in July, declined to £197 in August and £183 in September. It will be observed that during September, the total value of imports was greater than the total value of exports, for the second time this year.

Motor Ship Construction Continues to Make Progress

Lloyd's Register of Shipping returns for the third quarter show that, for the first time this year, the tonnage launched was in excess of the tonnage commenced, pointing to a falling off in the demand for ships. Recently placed orders, however, give good grounds for anticipating that the final quarter of the year may show a substantial improvement. In 1928, the tonnage commenced improved from 244,691 tons in the September quarter to 431,758 tons in the December quarter. During the past quarter the vessels commenced aggregated 360,087 tons, compared with 369,445 tons launched, a reversal of the position obtaining during the June quarter, when the launchings amounted to 392,888 tons, and 428,400 tons of new construction were put in hand. British shipyards are, at present, responsible for 51.4 per cent of the world's output, while of the British total 23 per cent is on Dominion and foreign account.

The motor ship continues to make progress, and the tonnage building in the world today that will be fitted with internal combustion engines amounts to 1,531,753, compared with steamers under construction totalling 1,275,019 tons. In this country, however, motorships are responsible for only 45 per cent of the tonnage, whereas abroad motor shipping provides 64 per cent of the work.

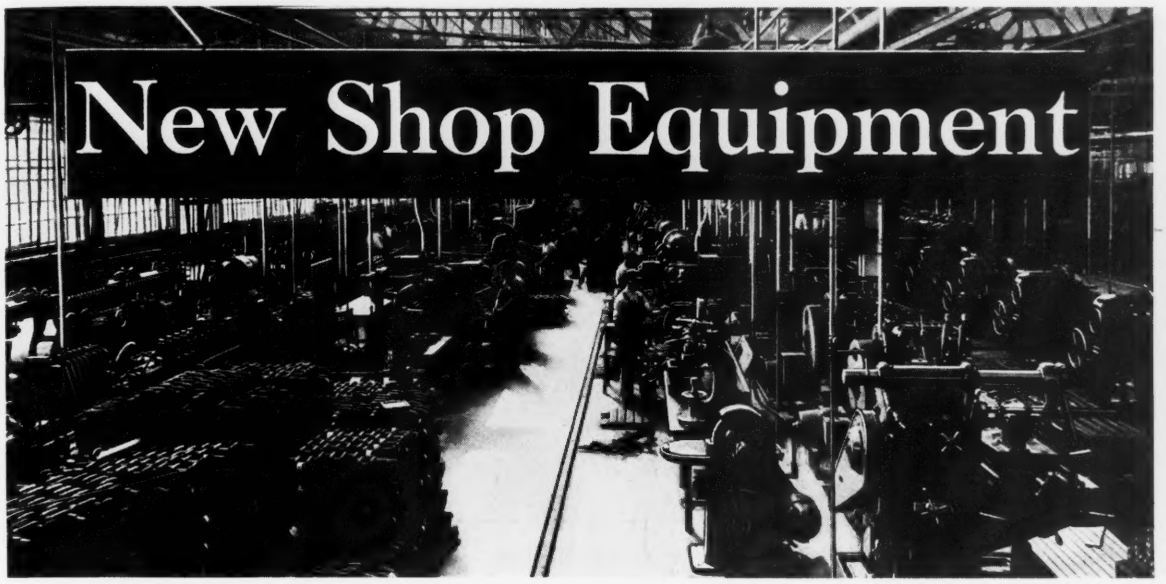
The Automobile Industry Works at High Pressure

At the larger automobile factories work is proceeding at comparatively high pressure on the new season's program. Those firms with overseas connections display the most promising signs, but taken as a whole, the position is very satisfactory for the time of year. A number of important contracts have already been placed for new cars, and these will insure steady work during the quiet months. Meanwhile, strenuous efforts are being made in many directions to develop the export trade, particularly in the Colonies.

Commercial vehicle manufacturers are generally well employed. An important event in this industry is the production, by Scammell Lorries Ltd., of what is claimed to be the largest road vehicle in the world. The motive unit, comprising an 80-horsepower engine, driver's cab, two-wheel front axle, and two oscillating driving axles arranged in line, is connected to the main chassis by a swivel joint. The chassis is supported at the rear by two axles each with four wheels. The rear set of four wheels is steered by a man seated on a platform at the end of the vehicle, and communicating with the driver by loud speaker telephone. The vehicle is intended for a maximum load of 100 tons, the normal maximum speed being 5 to 6 miles per hour.

Electrification Plans Give Impetus to Activities in Railway Engineering Field

In view of the large sums that are to be spent on the development and modernization of the railways during the next few years, it would appear that a considerable amount of work will be available for locomotive and rolling stock builders. The announcement that the main line from London to Brighton on the Southern Railway is to be electrified is of especial interest in view of the fact that this will be the longest electrified route in Great Britain and the first main line to be completely equipped for electric traction. Extensions of the London tube railways are also to be put in hand, the estimated cost of which is £13,000,000.



A Monthly Record of the Latest Developments in Metal-working Machinery, Small Tools, and Work-handling Appliances

BRADFORD SPECIAL DRILLING AND REAMING MACHINES

Two semi-automatic machines, one for drilling and reaming holes in automobile differential cases, and the other for drilling oil and connecting holes in gas-engine crankshafts are shown in Figs. 1 and 2, respectively. These machines have recently been placed on the market by the Bradford Machine Tool Co., 657-671 Evans St., Cincinnati, Ohio.

The machine in Fig. 1 drills twelve holes 23/64 inch in diameter through the flange of the differential cases, and also drills and reams two cross-pin holes 0.8625 inch in diameter. The material is malleable iron. In the operation of this machine, the operator clamps one part in the fixture by means of the quick-acting clamp, and trips a hand-valve mounted on the table at his left; this valve controls the air supply to the small cylinders attached to the tripping levers of the three heads. All spindles then advance simultaneously for the operations, after which they return to the starting point and stop, thus completing the cycle. The floor-to-floor time is sixty seconds, and one operator handles from two to four machines.

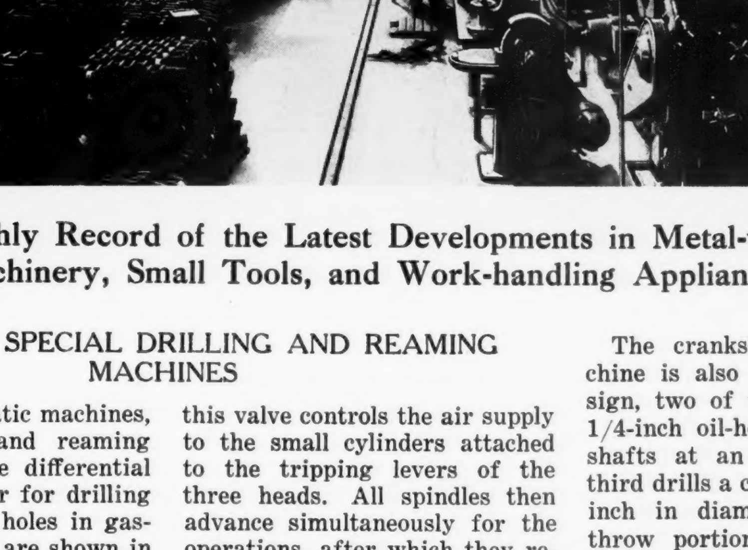


Fig. 1. Bradford Three-head Machine Designed for Drilling and Reaming Differential Cases

The crankshaft drilling machine is also of three-head design, two of the heads drilling 1/4-inch oil-holes in the crankshafts at an angle, while the third drills a connecting hole 7/8 inch in diameter through the throw portion. This operation is performed in a floor-to-floor time of six minutes, the part being a steel forging.

After clamping the work in the fixture, the operator trips the feeding mechanism of all heads simultaneously through the hand-valve at the front of the machine. The master head, which is located at the right front of the table, then drills to a depth of 4 inches before the 1/4-inch drills penetrate the 7/8-inch hole produced by it, and then returns to the back position. After the two 1/4-inch drills have started on their return stroke, the

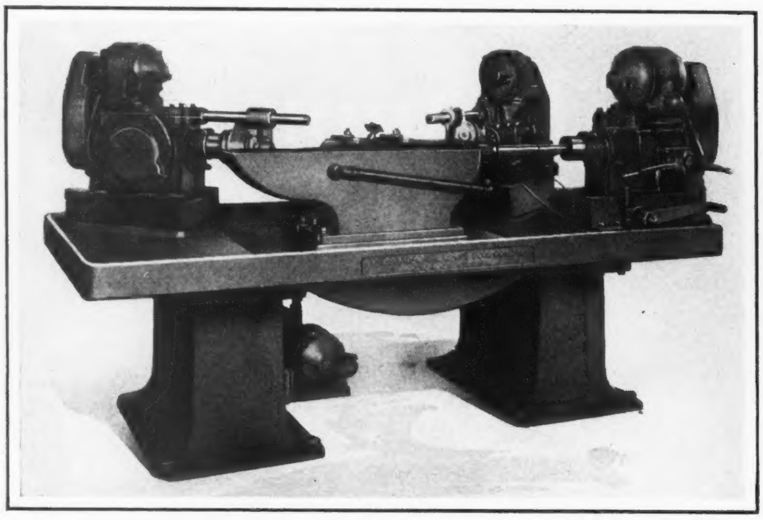


Fig. 2. Semi-automatic Three-head Machine for Drilling Oil and Connecting Holes in Crankshafts

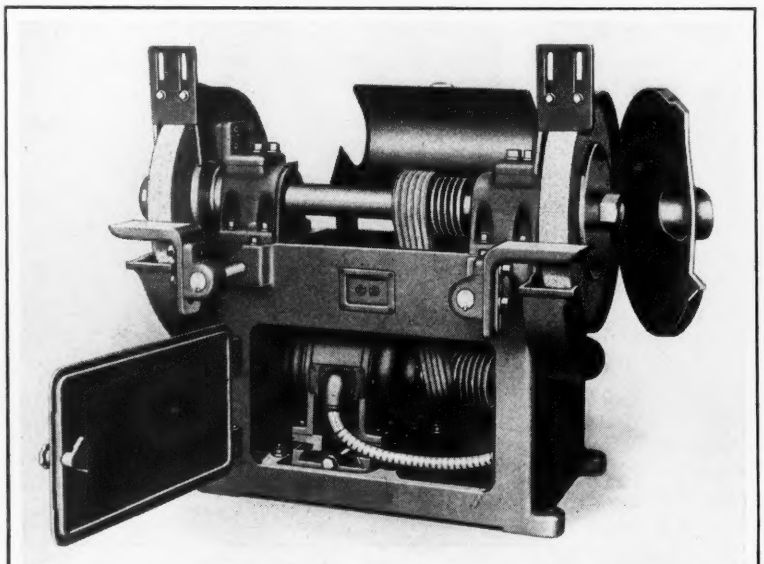
operator advances the master head to the front station in the slide by means of the hand-lever located at the front of the head and trips the feed of this head for a second cycle, during which it drills to the full depth of 7 7/8 inches.

HISEY SINGLE- AND MULTI-SPEED GRINDERS WITH "TEXROPE" DRIVES

High-speed grinders equipped with "Texrope" drives have been brought out in single- and multi-speed types by the Hisey-Wolf Machine Co., Cincinnati, Ohio. The single-speed machines are built in three sizes intended to take 24-, 20-, and 18-inch wheels, and to operate at spindle speeds of 1550, 1800, and 2000 revolutions per minute, respectively. The machines are particularly recommended by the manufacturer for use in banks of three or multiples thereof, so that as the grinding wheels become worn they can be changed to machines of higher spindle speeds. Thus, the 24-inch wheels can be operated at a peripheral speed of 9500 feet per minute when new and also when worn to a diameter of 18 inches.

The multi-speed machine is designed to use a 24-inch wheel operating at a surface speed of 9500 feet per minute. When the wheel has been worn down to 20 inches in diameter, the spindle speed can be increased by merely moving the wheel guards back so that a safety device can be operated, transferring the "Texrope" belts to the smaller driven pulley. When this has been done, the surface speed of the wheel will again be 9500 feet per minute. The safety device automatically insures that the speed of the grinding wheels will not drop below 7500 feet per minute nor be increased above 9500 feet.

The weight of the single-speed machines ranges from 2200 to 2430 pounds, while the weight of the multi-speed machine is 2525 pounds.



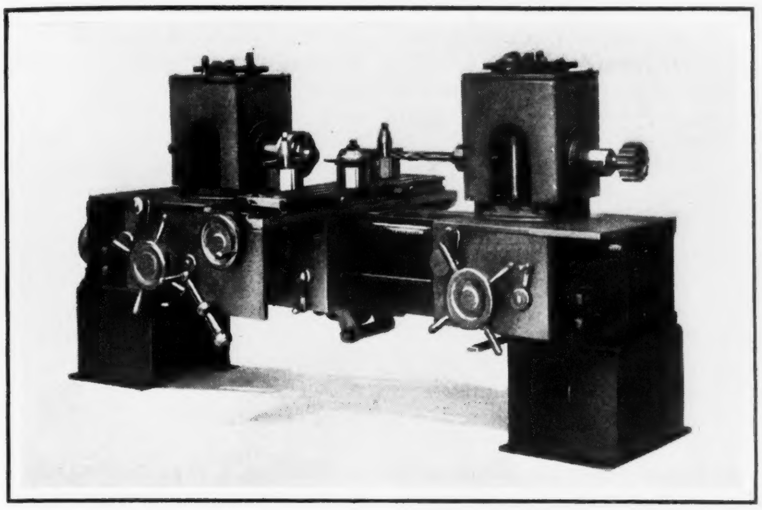
Hisey Multi-speed Grinder with "Texdrive"

"MULTIMECHANIC" GENERAL-PURPOSE MACHINE

A machine designed for performing lathe, drilling machine, milling machine, and shaper operations is being placed on the market by the Simplex Mfg. Co., N. 231 Howard St., Spokane, Wash. This "Multimechanic" is here illustrated set up for lathe work, three toolposts being mounted on the table for turning, facing, boring, and cutting-off work held in a chuck mounted on the left-hand turret. A fourth toolpost can be provided for holding a keyseating tool.

For turning parts with angular surfaces, such as bevel gears, the work-head turret can be swiveled to the required angle and locked. Cones can be threaded or spiral cuts taken on them by engaging the longitudinal and transverse feeds simultaneously.

Holes can be drilled in work in different locations by merely elevating the turrets, in either of which drills may be mounted. In boring operations, a bar can be driven by a rotating spindle and fed forward by transmitting the drive of the feed-screw to the turret. Work may be milled by cutters that are mounted in the spindle of either turret.



"Multimechanic" Machine which Performs the Work of Several Types of Machine Tools

This machine is built in various sizes and in modified forms to suit different kinds of work. For instance, several machines may be arranged side by side and provided with one long table for taking successive milling cuts on the same pieces.

OESTERLEIN "MIL-O-MATIC"

Hydraulic table operation is one of the principal features of the No. 36 "Mil-O-Matic" bed-type milling machine recently introduced to the trade by the Oesterlein Machine Co., Cincinnati, Ohio. This machine may be equipped with either a plain reciprocating table having a working surface of 21 by 48 inches and affording 36 inches of feed, or with an automatic indexing table having a working surface of 14 by 24 inches. The indexing table is mounted on a slide which can be fed 24 inches. Arranged as an indexing machine, the table makes a half turn at the end of its return stroke and then advances again to the cut. The design is such that single-, duplex-, vertical- or multiple-spindle machines are available, with several standard bed and table lengths. Special heads can also be applied.

The spindle head is a self-contained unit carrying its own motor; starting, stopping, and reversing mechanism and control lever; pick-off gears for obtaining different speeds; and adjustable controls. The head can be mounted at any angle or in any position. When the starting lever is pulled forward, the spindle is run in the right-hand direction, and when it is pushed backward, the spindle is run in the reverse direction. In the neutral lever position, the power is disengaged and the spindle stopped.

In the base of the column on which the spindle head is mounted there is a compartment for the direct-connected motor-driven Oilgear unit that furnishes the table feed. This arrangement leaves the entire bed practically clear of mechanism and available for chips and coolant. The column is keyed and bolted to the bed, and a heavy tie-piece interlocks it to an outboard bearing support. For lighter jobs or on duplex machines, the tie-piece and outboard bearing support may be omitted and a V-flat over-arm mounted on the spindle head instead.

The bed and table have ways made of hardened and ground steel strips. These surfaces are provided with constant forced-feed lubrication when the machine is running. The indexing table is mounted on a pair of radial ball bearings.

In the operation of the machine, the operator clamps the parts to be milled and then merely moves the lever to start the quick advance of the table. From this point, the machine operates automatically, the operator's only duty being to reload the fixtures. From the quick advance, the table movement slows down to the feed for which it is set.

At the end of the cut, the quick return is automatically engaged to bring the table back to the starting position at the

"Mil-O-Matic" Bed-type Milling Machine with Automatic Hydraulic Table Drive

rate of 180 inches per minute. Near the end of the return stroke, a Geneva mechanism unlocks the indexing table, returns a ratchet, and withdraws the table-locating plunger. Then, at the extreme end of the return stroke, if the machine is set to repeat, the forward quick travel begins again, and in the first 2 1/2 inches of forward motion, the table is automatically indexed by means of the ratchet.

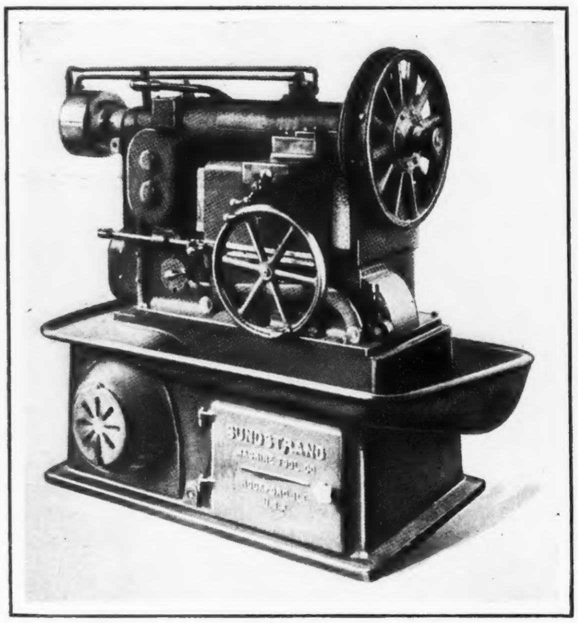
Upon leaving the Geneva rack, the indexing mechanism, being disengaged, automatically ceases to function. The inertia of the revolving table carries it forward until a spring sets the plunger for locating the table radially. When this plunger moves into place, it releases the interference to the clamping-ring locking device and thereby permits the clamp ring to lock the table. In order to accomplish this smoothly, there is a slight hesitation in the forward motion of the slide, after which the quick advance continues to the cutting point. The feed rate is then reengaged.

A cam plate is used for operating the lever that controls the pumping mechanism and governs the rate and direction of table motion. Either constant, varying, or intermittent feed is available, depending upon the contour of the cam used. Under ordinary conditions, springs operate a load-and-fire device and keep the control lever on one side or the other of neutral, so that the table automatically continues to reciprocate and index. However, an interference device is provided which may be set to stop the table at the end of its travel.

The machine is equipped with a pump having a capacity for delivering 40 gallons of coolant per minute to the cutters. A 10-horsepower motor is required to drive each standard spindle to capacity, a 5-horsepower motor is used for driving the Oilgear unit, and a 1/2-horsepower built-in motor is provided with the pump. A complete single-spindle machine, furnished with the tie-piece and outer arbor support, weighs approximately 14,000 pounds. The normal range of spindle speeds is from 20 to 242 revolutions per minute, and the table feeds range from 0 to 30 inches per minute.

SUNDSTRAND BRAKE-DRUM STUB LATHE

A stub lathe designed particularly for turning automobile brake-drums after they have been attached to the wheels has been added to the line of equipment built by the Sundstrand Machine Tool Co., Rockford, Ill. The machine follows the general design of the standard stub lathe manufactured by this concern, the main differences being that the bed has been shortened, the carriage feed reversed, and the spindle lengthened so that a wheel and brake-drum can overhang the right-hand end of the bed.



Sundstrand Stub Lathe Modified for Turning Automobile Brake-drums

Front and rear tool carriages are provided for taking roughing and finishing cuts simultaneously, but when one operation suffices, the rear slide can be omitted. Unmounted drums can also be turned readily. Any desired method may be used for supporting and driving the work, the general practice being to employ an air-operated work-holding device.

Twelve spindle speeds, ranging from 40 to 265 revolutions per minute, and ten feed changes of from 0.005 to 0.046 inch per revolution of the work are available. Both carriages have a longitudinal travel of 6 inches. Without a motor, the machine weighs about 3100 pounds.

HYDRAULIC PLASTIC MOLDING PRESS

A plastic molding machine consisting of a main press with a heating station, a sub-press with a cooling station, and an indexing table which transfers the molds from one station to the other has been developed by the Western Electric Co. under the direction of W. G. Altpeter and D. V. Waters. The design is based on the principle conceived by G. Howlett Davis. The Busch-Sulzer Bros.—Diesel Engine Co., St. Louis, Mo., has been licensed to build and market the machine.

As may be seen in Fig. 1, the heating station is at the rear of the machine. It consists of an upper stationary platen and a lower platen which is raised by the main hydraulic ram and lowered by hydraulic pull-backs. When the lower platen is raised, it lifts the mold from the indexing table and presses it against the upper platen. Both platens are equipped with steam heating channels that heat the molds by conduction.

The cooling station at the front is similar to the heating station, except that the upper platen is attached to a tilting head

equipped with hooks for lifting the upper half of the mold. The capacity of the sub-press ram is less than that of the main ram, as it is used only during cooling and for closing and stripping the molds. The platens at the cooling station are provided with water-cooling channels.

Two sets of dies are in constant use. While one mold is being heated, the other is being cooled, unloaded, and refilled for the succeeding cycle. The time required for the operation at each station is about the same, and so the only time lost in each cycle is that consumed in indexing the table. The dies used in the machine illustrated mold the mouthpieces of telephone transmitters. Forty-nine mouthpieces are turned out in four minutes.

In the operation of the press, with the empty mold on the table at the cooling station, the tilting head is lowered and the stripping fixture seen at the left in Fig. 2 is rolled under the mold and raised by the sub-press ram. As the top half of the mold comes in contact with the tilting head, it is retained in that position by hooks which hold it while the tilting head rises and lifts the top half of the mold with it.

A fixture is then placed over the lower half of the mold to apply any inserts required. These inserts may be forced into place by lowering the tilting head and raising the sub-press ram momentarily. The insert fixture is next removed and a loading fixture placed over the lower half of the mold to measure into each cavity the proper quantity of material in powder or biscuit form. The loading fixture is then removed and the excess material brushed from the surface of the mold.

The top half of the mold is next lowered into position and the sub-press ram advanced to close the mold, after which the hooks are released and the tilting head raised. Then, the main ram is lowered, the indexing device is automatically released, and the table revolved 180 degrees about its vertical axis to bring the freshly loaded mold to the heating station and the cured mold to the cooling station.

Next the main ram is raised and the curing of the fresh mold under pressure begins. Simultaneously, the tilting head at the cooling station is lowered and the sub-press is raised to cool the previously cured mold. After the cooling, the sub-press ram is lowered and the stripping fixture is rolled on a track under the mold. Then the sub-press ram is again raised to cause the knockout pins of this fixture to push the molded pieces free, the top half of the mold being raised at the same time into contact with the tilting head. The ram is then lowered. Finally, the top half of the mold is lifted off by the tilting head, and a finger fixture is used to lift the molded pieces from the dies.

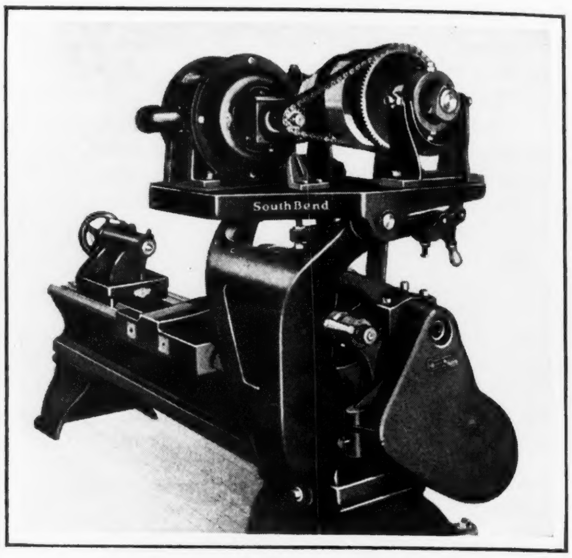
Fig. 1. Plastic Molding Press with Tilting Head at Cooling Station Raised for Loading

Fig. 2. Molding Press in Operation Simultaneously Curing and Cooling Telephone Mouthpieces

HAMMOND HEAVY-DUTY BUFFING AND POLISHING LATHE

An "Ace" heavy-duty four-bearing electrically driven polishing and buffing lathe, built by the Hammond Machinery Builders, Inc., Kalamazoo, Mich., in a complete range of sizes from 3 to 15 horsepower in capacity, is shown in the accompanying illus-

Hammond Buffing and Polishing Machine with Four Ball Bearings for the Spindle



South Bend Bench Lathe Equipped with Silent-chain Motor Drive

tration. The motor of this equipment is totally enclosed, having no holes or open slots for ventilation. Clean air is supplied by a patented device that does not require piping to outside sources. The motor is designed to withstand a momentary overload of 100 per cent, and will not become heated to a temperature higher than 40 degrees C.

There is a push-button control mounted on the front of the pedestal, and a Cutler-Hammer automatic motor starter, having thermal overload and low-voltage protection, is mounted on the pedestal door. Four ball bearings support the one-piece chrome-manganese steel spindle.

Two-bearing machines are supplied in four sizes, ranging from 1 1/2 to 5 horsepower in capacity.

SILENT-CHAIN DRIVE FOR BENCH LATHES

The South Bend Lathe Works, 768 E. Madison St., South Bend, Ind., has brought out a silent-chain motor drive for application to the complete line of bench lathes manufactured by this concern, including both the 9-inch regular and 9-inch "Junior" models. In the new drive the motor, the enclosed and automatically lubricated chain drive, and the jack-shaft cone pulley are mounted over the lathe headstock on a substantial bracket and tilting table, as shown in the illustration. Thus, they are out of the way of the operator and protected from chips and dirt. The belt tension is adjustable independently of the tilting arrangement. The belt can be easily shifted.

CINCINNATI CUTTER GRINDER

The new No. 2 cutter grinder introduced on the market by the Cincinnati Milling Machine Co., Cincinnati, Ohio, at the National Machine Tool Builders' Show held recently in Cleveland, embodies new and improved features resulting in convenience, accuracy, and rigidity. The bed of this machine has a three-point support on the floor and a large accessible compartment for the self-contained motor. The machine has a fixed-height table and a fixed operating position for all types of cutter grinding. Ease of operation is obtained by mounting the table on a sensitive roller-bearing support. It is stated that with a man of average size standing on the table, the table movement is still easy and free.

The table slide rides on two long roller chains guided by four ball bearings, two on each end. The saddle is accurately adjusted crosswise up to 10 inches by turning the handwheel at the left of the front side. Means for making the same adjustment are duplicated at the rear of the machine. Two fixed narrow-guide inverted vee-bearings that are never exposed support the saddle. The table proper can be swiveled and is equipped with the regular graduated swivel dial, a scale giving tapers in inches per foot and means for fine adjustment.

A fine handwheel movement, desirable in cylindrical and surface grinding, is obtained by engaging the knurled knob of the circular box at the right-hand side of the machine and then moving the table by turning the crank. Engagement of this knob prevents the table traverse in either direction except by means of the crank, which is a valuable feature in setting up a job. The knurled knob at the rear is used for ordinary cutter grinding. The over-all or working surface dimensions of the table are 5 1/4 by 36 inches, and the movement in line with the centers is 18 inches. Work up to 10 inches in diameter can be swung between centers. Facilities have been provided for attaching new-style tooth-rests for any kind of cutter grinding.

The grinding-wheel spindle

head is mounted on a column that may be adjusted vertically and horizontally. This column is graduated in degrees from 0 to 240 for swivel movements. Vertical adjustments are made by turning a handwheel equipped with a dial graduated to 0.001 inch, the handle being located on the left-hand side of the machine just beneath the saddle. The maximum vertical adjustment is 7 1/2 inches.

The grinding-wheel spindle head is driven by a 1/2-horsepower motor running at 3425 revolutions per minute, which must be supplied at the factory. The motor shaft and spindle are parallel, and power is transmitted through a straight belt that never twists or crosses, even though the spindle may be swiveled and raised from its lowest to its highest position. A two-step cone-pulley arrangement provides two wheel speeds of 3850 and 5735 revolutions per minute. The spindle has a ball-bearing mounting.

The work-head holds the shanks of end- and face-mills for sharpening in the same manner as they are held in the nose of milling machine spindles. The work-head can be swiveled in vertical and horizontal planes. The Cincinnati patented clearance setting dial has been retained in the machine for making direct and positive settings for any required clearance angle. The spindle of this head is provided with the National Standard taper hole in one end, and a No. 12 Brown & Sharpe taper hole in the other end.

This grinder is built in both plain and universal types, the universal machine consisting of the plain machine with the addition of cylindrical and surface grinding, gear-sharpening, and internal grinding attachments. Universal machines only are supplied with a motor-driven work-head. The plain machine weighs 1600 pounds, and the universal machine, 1750 pounds.

BLOUNT GRINDER FOR TUNGSTEN-CARBIDE TOOLS

An improved wet tool grinder intended especially for grinding tungsten-carbide tools is manufactured by the J. G. Blount Co., Everett, Mass. The special wheel provided when the machine is to be used for tungsten-carbide tools is said to afford an easy, rapid method of grinding without danger of burning or checking the tools.

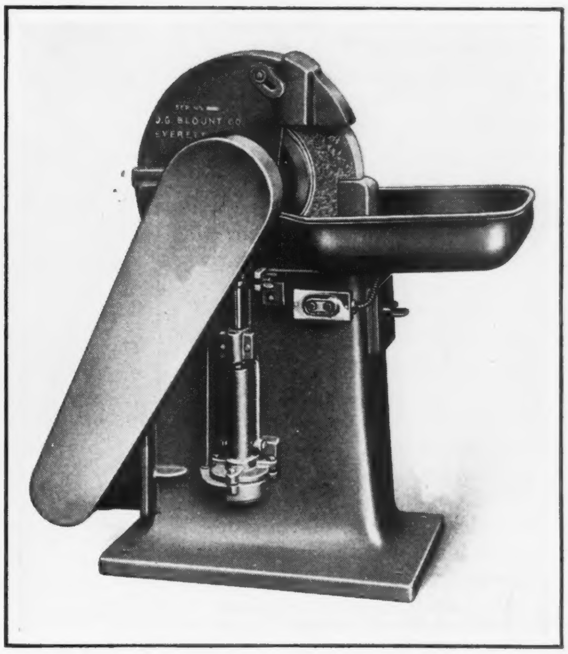
The machine is equipped with a heavy spindle running in self-oiling bearings. In the column there is a reservoir for water supplied to the wheel through a friction-driven centrifugal pump. The bearings of the pump spindle are located outside of the pump to eliminate any wear from possible grit in the water. The water is supplied to the rear of the wheel under force, assuring a clean wheel at all times and permitting tools to be ground without interfering with the vision of the operator.

This machine is made in three sizes, taking 14- by 1 1/2-, 20- by 2 1/2-, and 30- by 3-inch wheels, respectively. Wheels may be furnished in various grits and grades, depending upon the service for which they are to be used. Either a belt or motor drive can be supplied.

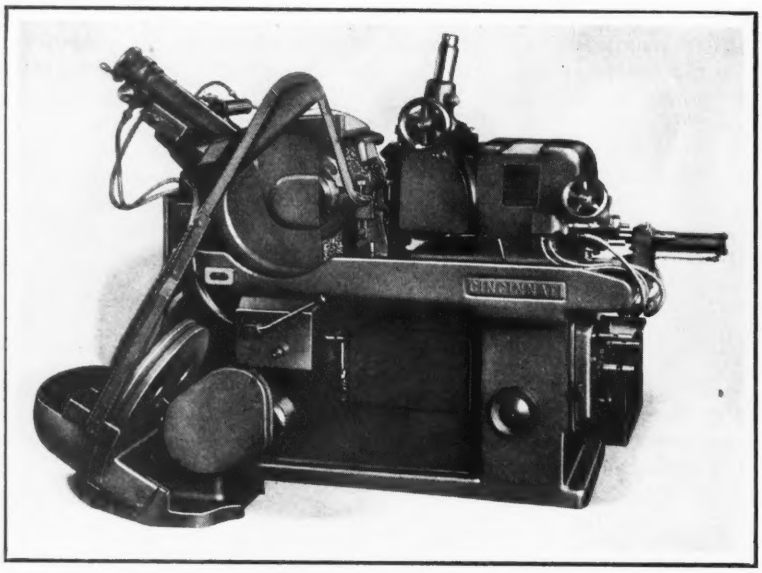
HOPPER FOR CINCINNATI CENTERLESS GRINDERS

Full-automatic grinding on straight cylindrical work such as piston-pins, small rollers, short shafts, bushings, and similar parts, can be performed in the centerless grinding machines built by Cincinnati Grinders, Inc., Cincinnati, Ohio, by using a floor-level hopper recently

Cincinnati New No. 2 Cutter Grinder



Blount Grinder for Tungsten-carbide Tools



Cincinnati Centerless Grinder Equipped with Automatic Floor-level Hopper

brought out by the same concern. This hopper makes it possible for one man to operate a battery of machines, as it eliminates all manual feeding. The sole job of the attendant consists of filling the work basin of the hopper provided for the first machine, and checking the size and finish of the pieces being ground.

By the use of these hoppers work may be fed consecutively through a series of machines, since the basin is low and gravity is utilized to bring the work from one machine to the hopper basin of another. Thus the work can be passed through successive machines until the exact size is obtained. The hopper can be easily disconnected.

An individual motor drive is furnished for each hopper. Variations in feed to suit the flow of work through a machine are obtained by means of a worm-gear reduction which is connected to a rotating carrier disk by interchangeable slip gears. Parts dumped into the work basin are carried upward to a delivery chute by a series of studs spaced around a ring which is interchangeable on the main carrier disk. Timing of the hopper is adjustable, so that work can be delivered slightly in excess of the machine requirements, a return chute being provided for carrying surplus work back to the basin.

DEFIANCE AIRPLANE PROPELLER LATHE

An improved machine for turning the flat winding portion of aluminum-alloy or wood propeller blades and struts such as are used on various types of aircraft has been brought out by the Defiance Machine Works, Defiance, Ohio. Although this machine is intended primarily for propeller blades, it can also be used for other irregular-shaped parts up to 5 feet in length and up to 12 inches in width or diameter. The machine is an adaptation of the Defiance copying lathe which produces facsimiles of the models employed. Both right- and left-hand pieces can be made from the same model, and by means of an adjustment, either end of the work or the entire piece can be made larger or smaller than the model.

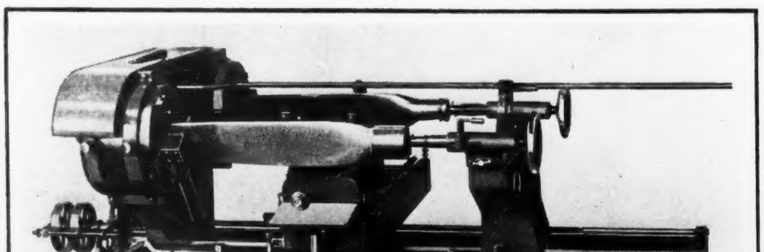
The screw-feeding mechanism may be used to feed the cutter-head carriage alternately from right to left and left to right or in one direction only. The feed-screw is driven by double friction pulleys operated by a convenient hand-lever, and is automatically disengaged at the end of the cut.

In turning aluminum-alloy propeller blades, a special milling cutter 12 inches in diameter, having a 1 3/8-inch circular nose or cutting edge, is used. This cutter is mounted on a sliding frame supported by the carriage.

There is a hollow chuck on both the model and turning sides of the machine for holding the propeller and model. At the tail-stock end, they are held in centers provided with ball thrust bearings. The machine has a net weight of 4260 pounds.

GREENLEE IMPROVED FOUR-SPINDLE AUTOMATIC SCREW MACHINE

The four-spindle automatic screw machine manufactured by Greenlee Bros. & Co., Rockford, Ill., is now equipped with a lead-screw threading mechanism by means of which threading, tap-



Defiance Airplane Propeller Blade Lathe

ping, reaming, chamfering, corner-rounding and other tools can be used in the third and fourth positions. Accurate threads are insured with this mechanism, and it is especially advantageous in producing short threads, since these can be cut easily without damaging the first thread. Setting up this attachment is simple and requires little time.

The cast-iron pan has ample coolant and chip capacity for long runs, and the strainer is so arranged as to be free from chips at all times. The machine bed is of the heavily ribbed box type, with an inverted-vee construction beneath the spindles. This design, together with a strong flow of coolant on the bed, keeps chips from accumulating under the spindle noses.

A hand-lever is provided for opening and closing the collet in the No. 1 position. The collet-closing fingers are counterbalanced to eliminate the varying effects of centrifugal force. Another particular feature is an independent feed for each forming slide, which greatly increases the range of screw machine work as different depths of cuts can be taken in each of the four spindle positions and different rates of feed used. For instance, heavy cuts can be taken in the first and second positions, a finishing cut in the third position, while the fourth position is used for cutting off. Pick-off cams are easily interchanged in the different positions for various set-ups.

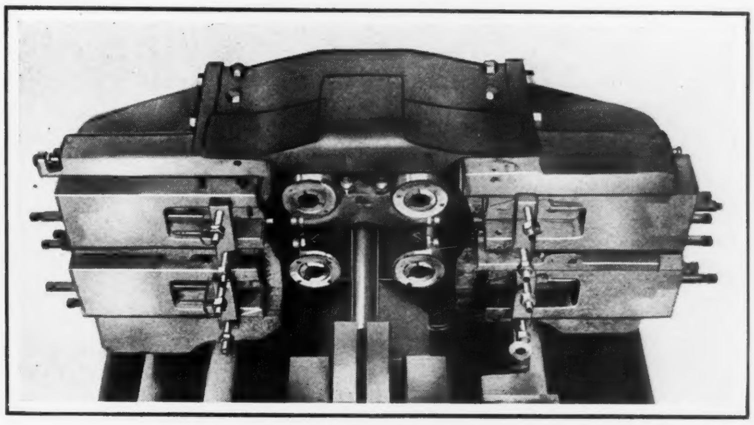


Fig. 2. Close-up View of the Four Forming Slides which have Independent Feeds

There is an interlock between the hand turnover and the feed control lever, so that the hand and power feeds cannot be engaged at the same time. The clutch that engages either the fast or feeding movement of the tool-slide is shifted by hydraulic action, which insures a positive movement at all times and eliminates shock when the engagement is made.

This four-spindle automatic screw machine is built in two sizes which take round stock up to 1 1/4 and 1 3/4 inches, respectively. With a motor drive, the weights of the two sizes are 8250 and 12,000 pounds, respectively.

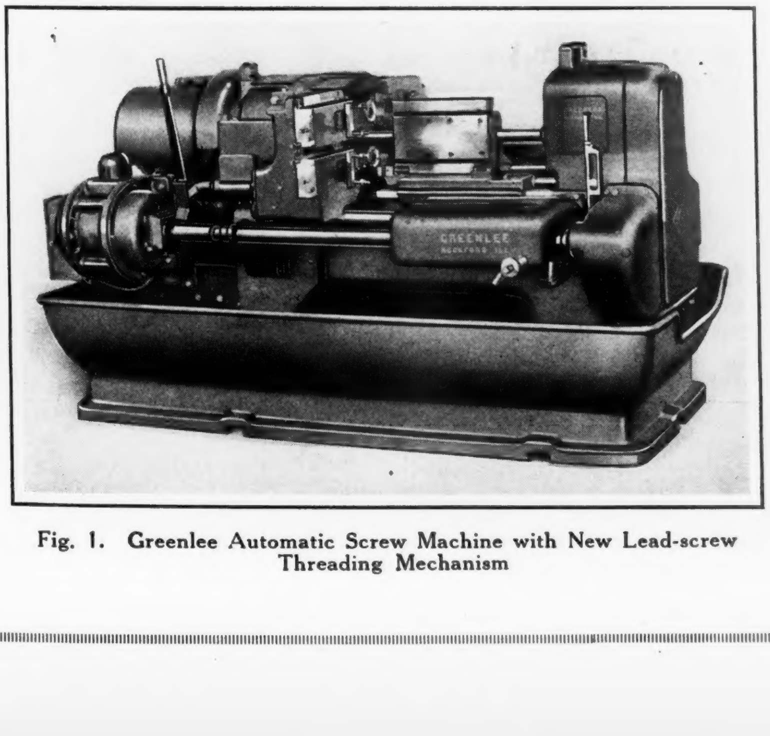


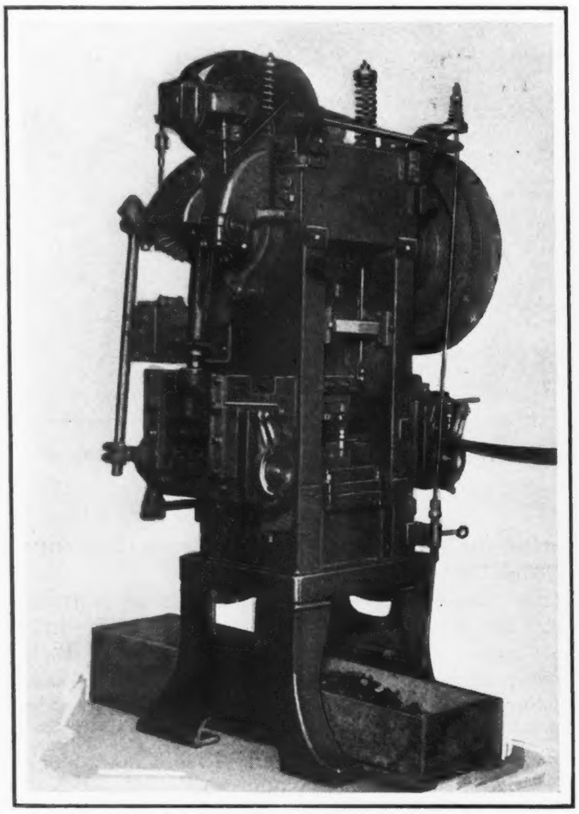
Fig. 1. Greenlee Automatic Screw Machine with New Lead-screw Threading Mechanism

BLISS HIGH-SPEED PRESSES

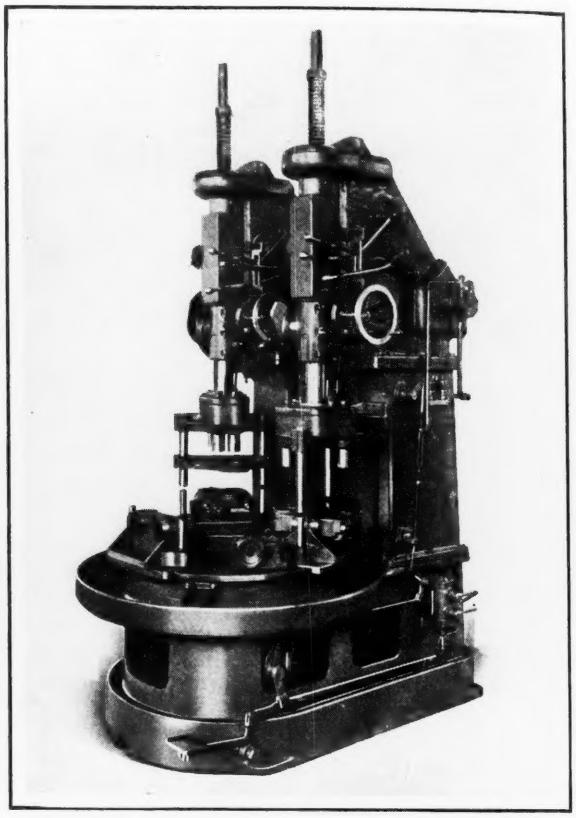
Four hundred strokes per minute have been maintained in a test conducted on a No. 630 high-production press recently built by the E. W. Bliss Co., Brooklyn, N. Y. In this test, stampings were blanked and formed in large quantities from 0.010-inch brass- and 0.014-inch steel-coiled stock. This machine is the 30-ton member of a line of presses built by the concern, and is rated at 300 strokes per minute.

With a view to insuring maximum life of the dies, the bed, bolster plate, and crown of each machine have been proportioned as they would normally be for presses of about 50 per cent greater capacity rating. The built-up and keyed-in side members are held by shrunk-in tie-rods under an initial tension greater than any load they may be called upon to take. The slide, large buttress screw thread in the slide, and the solid one-piece connection have been designed to take the compression load, all bending stresses being absorbed in the deep bed and crown. The stroke is preferably short.

The Bliss high-production double-roll feed is employed. The hardened and ground hollow steel rolls of this feed are controlled by brakes, and independent roll-relief and feed-stroke adjustments permit very close settings. The scrap cutter used with these machines has "Neor" steel blades for cutting silicon steel and other hard scrap.



Bliss Press which was Operated in a Test at 400 Strokes per Minute



Barnes Drill Co.'s Drilling Machine with Hydraulic Indexing Table

Die sets are recommended for convenience in setting up the dies, but they are not actually necessary in operation, as the "Tripod" three-point gibbing is said to maintain accuracy of alignment even better than closely fitted guide-pins. There are only two sizes of adjusting-bolt heads, so that a set-up can be made with two wrenches.

Among other features of these machines are a hardened chrome-nickel steel rolling-key clutch with backing pawl, Manzell force-feed lubricator with separate piping to all main bearings, springs for counterbalancing the slide, and a "Texrope" drive from the motor. The latter is mounted on top of the press. The extra large opening under the bed facilitates the use of chutes, stackers, etc. For cleanliness, the main bearings are oil-trapped and fitted with drip pans from which the oil is piped to the sump around the bed.

BARNES DRILL CO.'S GANG DRILLING MACHINE WITH HYDRAULIC INDEXING TABLE

A two-spindle production gang drilling machine recently developed by the Barnes Drill Co., 814 Chestnut St., Rockford, Ill., is equipped with a built-in rotating hydraulically controlled table, as illustrated. This hydraulic table may be of either the three- or the four-station indexing type. The hydraulic mechanism is enclosed within the machine frame.

Other new features of the equipment include an enclosed construction of the spindle sleeve and spindle between the upper crown-gear housing and the spindle-sleeve bearing of each gang head. This construction eliminates the possibility of chips getting on the spindle sleeve and scoring its bearing, and makes possible the self-oiling of each spindle in its sleeve. The spindle sleeve has a split bearing, the bearing cap being made of Gunite metal.

The spindles and their sleeves are made of Nitralloy, and are heat-treated by the Nitriding process after all machining and grinding has been done. This heat-treatment makes it possible to apply roller bearings in recesses at each end of the spindle sleeves, so that the rollers are in direct contact with the spindles and the sleeve recesses.

Another new feature is a sweeper fastened to the under section of the rotating table, which pushes the chips into a steel pan at the rear. The coolant on the chips passes through perforations in the pan into the machine base.

The first spindle of the machine illustrated is equipped with a cam feed to give a rapid approach to the work, then a feed at a predetermined rate, a dwell for facing, and, finally, a quick return. The second spindle has a similar cam feed adaptable both for reaming and tapping, according to the set-up. Two pieces are bored simultaneously in the first station under a multiple head

equipped with guide bars while two others are being reamed in the second station, or, in some operations, tapped.

The speed-change transmission and the spiral crown gears are equipped with Timken tapered roller bearings, while the drive shaft and handwheel shaft have radial ball bearings. Equipped with a 10-horsepower motor and all attachments as shown in the illustration, the machine weighs 9760 pounds.

CANEDY-OTTO SLIDING-HEAD MOTOR-DRIVEN DRILLING MACHINE

A 20-inch sliding-head drilling machine having a direct belt drive from the motor to the spindle has been added to the line of drilling equipment built by the Canedy-Otto Mfg. Co., Chicago Heights, Ill. The principal advantages claimed for this drive are simplified construction and the elimination of idlers, pulleys, and twisted or turned belts. The driving units are entirely equipped with Timken roller bearings, the motor and motor-cone pulley with ball bearings, and the spindle cone with roller bearings. The spindle itself is ground, and is equipped with two sets of ball bearings. All pulleys are dynamically balanced on a Gisholt balancing machine.

The machine is provided with a push-button control and magnetic switch. The belt can be conveniently tightened by simply moving the sliding member to which the motor is attached. Four changes of feed are obtainable while the machine is in operation. This drilling machine can be furnished in two-, three-, and four-spindle types with a center distance between the spindles of 14 1/2 inches. The single-spindle machine weighs 1220 pounds.

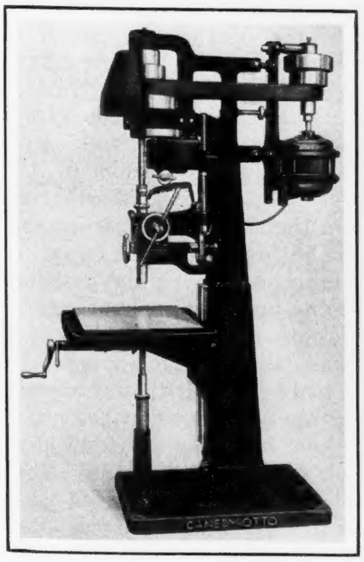
IDLING DEVICE FOR LINCOLN WELDERS

An automatic idling device or throttle control for regulating the speed of the engine in "Stable Arc" welders of the gasoline-engine driven type has recently been brought out by the Lincoln Electric Co., Cleveland, Ohio. This device automatically increases the speed of the engine from the normal idling speed to the proper speed for welding whenever the arc is struck. When welding is discontinued, the device automatically reduces the engine speed to the normal idling rate.

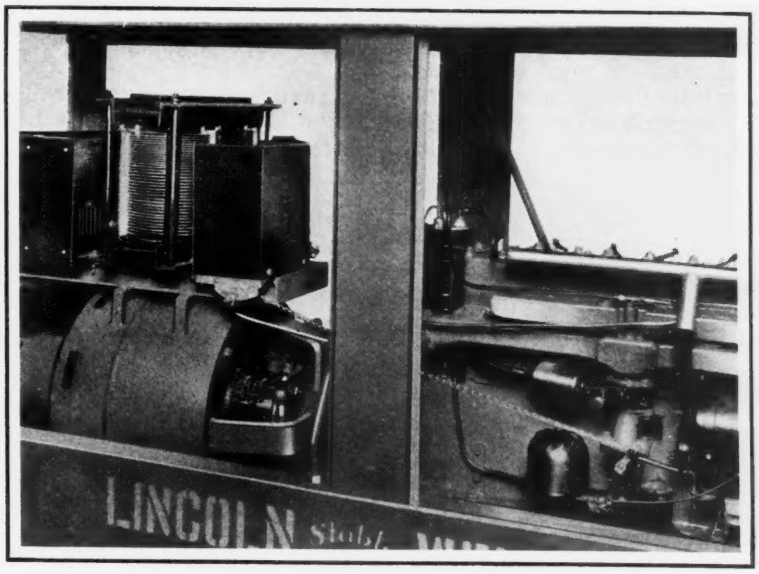
The operating mechanism consists principally of a small metal bellows and an electric magnet. When the arc is struck, the armature of the electric magnet opens a relief valve in the bellows, causing them to inflate which, in turn, allows a spring to open the engine throttle. At the end of a welding operation, the bellows are deflated by the suction of the engine intake, thus causing the engine throttle to close to the idling position. The device is provided with a control lever which may be set for automatic throttle control, for continuous idling speed, or for governed speed. It is estimated that the use of this device will effect a 25 per cent saving in fuel consumption.

BROWN & SHARPE MICROMETERS AND WIRE GAGE SELECTORS

Two micrometer calipers and a wire gage selector recently added to the products of the Brown & Sharpe Mfg. Co., Providence, R. I., are shown in Figs. 1, 2, and 3. An outstanding feature of the No. 24 micrometer caliper illustrated in Fig. 1 is that it measures direct to 0.0001 inch, the tool having a range of from 0 to 1 inch. Thousandths of an inch are read from the barrel and thimble in the regular manner, while the readings in ten-thousandths of an inch are obtained direct from the small lower thimble. Widely spaced graduations permit closer dimensions to be estimated.



Canedy-Otto Sliding-head Drill



Lincoln "Stable Arc" Welder Equipped with Idling Device

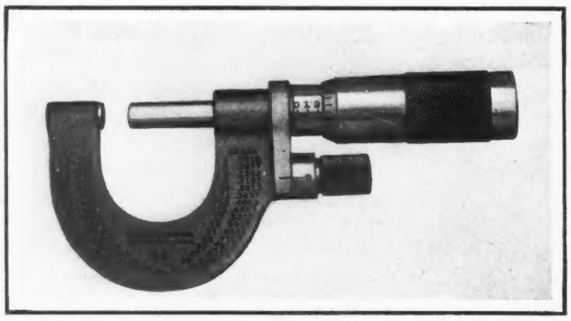


Fig. 1. Brown & Sharpe Micrometer Caliper which Reads Direct to 0.0001 Inch

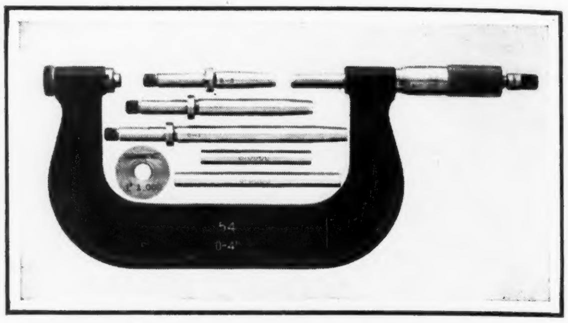


Fig. 2. Micrometer with Four Anvils and Three Standards for Measuring from 0 to 4 Inches

This micrometer caliper is used in much the same way as the conventional 1-inch micrometer. After the spindle has been brought against the object to be measured, the small thimble is turned until the horizontal line on the barrel coincides with a graduation on the main thimble.

Fig. 2 shows a No. 54 micrometer which has a range of from 0 to 4 inches in thousandths of an inch. This tool is especially adapted for use in automotive service shops, as its range includes all parts requiring close measurement, such as pistons, camshaft bearings, wrist-pins, crankshaft bearings, and crankpins. Four interchangeable anvils are furnished, together with a ratchet stop and a set of three standards.

The wire gage selector shown in Fig. 3 is one of two designed to simplify the gaging of wire in quantity. These Nos. 698A and 698B selectors may be used to cover up the slots in wire gages adjacent to the slot being used, so that one slot is made accessible for the fast gaging of any particular size of wire. The selectors are quickly attached to wire gages, as the spring fingers of the selector arm snap around the stud on the disk of the wire gage to hold the selector in place. Selector No. 698A is intended for use on B. & S. wire gages Nos. 688 (5 to 36) and 690 (6 to 36); while selector No. 698B is for use on B. & S. wire gages Nos. 688 (0 to 36), 690 (1 to 36), 692, and 694.

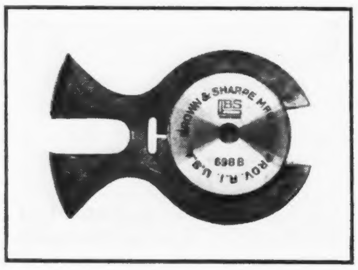


Fig. 3. Selector for Simplifying the Gaging of Wire

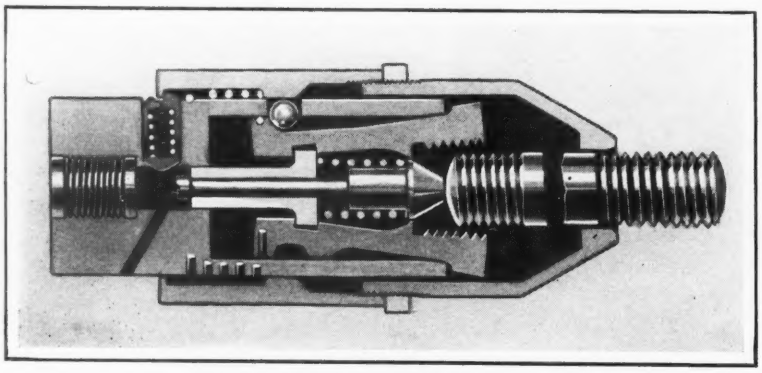
TITAN QUICK-RELEASE STUD-SETTER

A self-opening device for driving stud bolts has recently been introduced on the market by the Titan Tool Co., Erie, Pa. This device may be applied to drilling machines of all types and to both portable and stationary air and electric drills. The tool is designed to work efficiently at either high or low speeds and at any angle. One of the features is that the positive drive is released automatically when the stud has been driven to a predetermined height. The seating is done without producing burred threads.

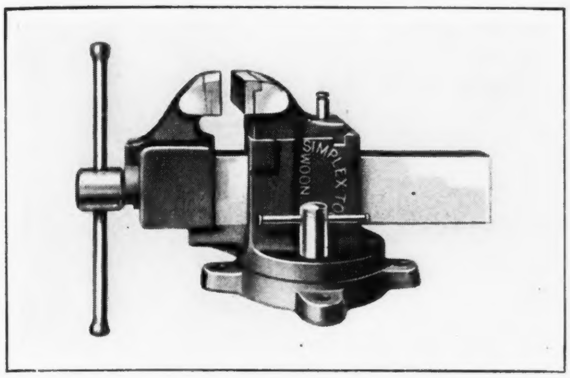
In operation, the tool may either be registered on a stud previously started in its seat by hand or the stud may be inserted in the tool, ready to be driven into a tapped hole. The positive drive is released when the gage sleeve pushes back the slip ring; this, in turn, releases the hardened steel driving balls, which move outward into a recess provided in the slip ring.

At this stage, the driving jaws remain completely registered with the stud, but to complete the operation cycle, it is only necessary to lift or pull the device from the stud. This is done with complete freedom from the driving force, thereby preventing the mutilation of the threads. As the tool is freed from the stud, the slip ring acts on the driving balls, forcing them into the driving position, and the jaws then open, ready to set another stud.

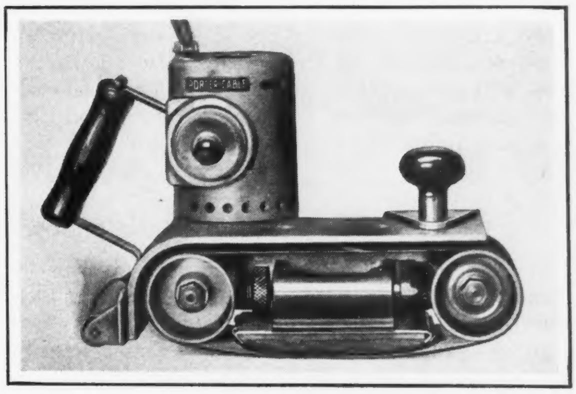
The jaws are so arranged in the tool body that they fit closely over studs even when the studs vary as much as 0.015 inch in pitch diameter. Studs as short as 1/2 inch may be seated with this tool. It is made in two sizes having maximum capacities for 1/2- and 7/8-inch studs.



Titan Stud-setter which is Released Automatically when a Stud is Driven in Place



Simplex Vise with a Swiveling Back Jaw for Holding Irregular Pieces



"Take-About" Sander which Runs at a Belt Speed of 1800 Feet per Minute

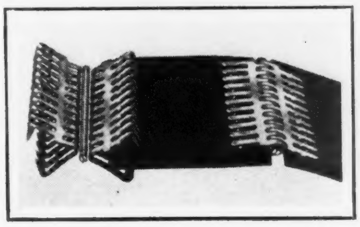
SIMPLEX VISE WITH SWIVEL BACK-JAW

The back jaw of the vise here illustrated is made in two parts, the top part being free to swivel so that irregular-shaped pieces can be held. This part can be locked to the back jaw proper by a pin when the swiveling feature is not necessary.

This vise is a recent product of the Simplex Tool Co., Woonsocket, R. I., and like all vises made by that concern, the sliding member of the front jaw is machined out of a solid steel bar. The nut for the operating screw is so designed that it cannot rise at the back and bind the screw in a manner that would limit the gripping power and make both the screw and nut likely to break. The removable jaw inserts are doweled in place, as well as screwed on.

"STEELGRIP" FLEXIBLE BELT LACING

A complete line of flexible belt lacing called "Steelgrip" has been placed on the market by Armstrong-Bray & Co., 28 N. Clinton St., Chicago, Ill. This lacing is made of a heat-treated steel which has unusual toughness and tensile strength and yet is hard enough so that the points of the lacing will go through the toughest belts and stand up under long continuous use. The joint of the lacing is made with a steel rocker pin composed of two segments, one of which rocks against the other and thereby absorbs the wear at the joint when it passes over the pulley. The lacing may readily be applied to a fabric, leather, or composition belt by using a hammer. Because the lacing is smooth on both sides and flexible, it is particularly suitable for an idler drive, and it is especially recom-



"Steelgrip" Flexible Belt Lacing

mended for conveyor service due to its strength and flexibility. The lacing is made for belts of from 3/16 to 1/2 inch in thickness and for any belt width.

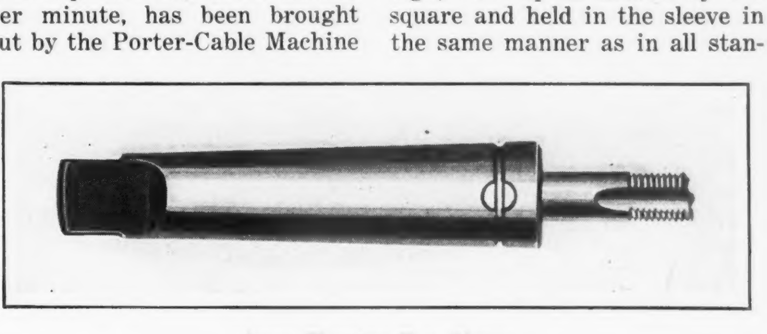
PORTER-CABLE "TAKE-ABOUT" SANDER

A "Take-About" sander that is equipped with a motor running at the high frequency of 180 cycles, which gives a maximum motor speed of 10,800 revolutions per minute, has been brought out by the Porter-Cable Machine Co., Salina and Wolf St., Syracuse, N. Y. Except for the speed, this model is similar in many respects to the Types B-4 and B-5 sanders. The motor is rated at 1 1/2 horsepower, and is capable of developing 1.9 horsepower, which is sufficient to drive the belt at a speed of 1800 feet per minute.

Because of the high belt speed, this sander is especially suitable for grinding and polishing metal work and for surfacing wood parts when a high rate of production is desired. The equipment takes a belt 3 by 25 3/4 inches, and weighs approximately 21 pounds. Among its applications are the finishing of lathe carriages, metal furniture, automobile bodies, doors and sashes.

APEX FLOATING TAP SLEEVES

Tap sleevs of floating design which can be used in any position and are intended for both single and multiple tapping operations have recently been developed by the Apex Machine Co., Dayton, Ohio. In this design, the tap is driven by the square and held in the sleeve in the same manner as in all stan-



Apex Floating Tap Sleeve

dard Apex tap collets. Since the bore and square of the sleeves are larger than the tap shank and square, the tap is free to float and follow the hole, thereby correcting any misalignment between the tap and the work. These sleeves are regularly made for hand taps up to 1 1/4 inches and pipe taps up to 1 inch

GRINDER WITH V-DISK TRANSMISSION

A floor-type alternating-current grinding machine embodying the Gibbs V-disk transmission of graphitized Micarta is built by the United States Electrical Tool Co., 2477 West Sixth St., Cincinnati, Ohio. One of the principal advantages claimed for this grinder is its ability to operate on alternating current. Another advantage is that the three available speeds permit maintaining an average wheel peripheral surface speed of approximately 9000 feet per minute, so that wheels can be used down to the flanges.

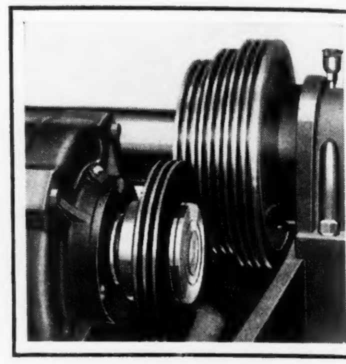


Fig. 2. Gibbs V-disk Transmission Applied to Grinding Machine

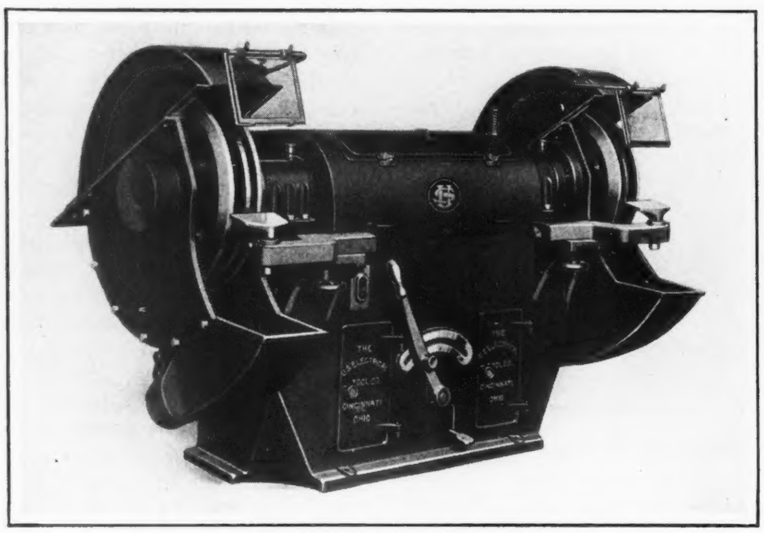


Fig. 1. Alternating-current Grinder Built by the United States Electrical Tool Co., with Gibbs V-disk Transmission

On a grinder that takes a 24-inch wheel, the wheel surface speed is 9500 feet per minute when the wheel is new and the spindle is run at its slowest speed. When the wheel has been worn down to 21 inches, the speed is 8500 feet per minute. The spindle speed can then be increased to give the 21-inch wheel a speed of 9500 surface feet per minute or a speed of 8300 feet per minute when the wheel is worn to 18 inches. At that time, the spindle speed may be increased again to give a wheel speed of approximately 9700 surface feet per minute, and a speed of about 8000 feet per minute when the wheel has been worn to the flanges.

The changes in spindle speed are obtained by merely operating the foot-pedal and hand-lever located at the front of the machine. In doing this, the metal transmission disks attached to the motor spindle, which are seen in Fig. 2, are lifted and replaced against the smaller disks on the wheel-spindle. The hand-lever is interlocked with the wheel guards, making it impossible to run the wheels at excessive speeds.

This grinder is built regularly in four sizes, carrying wheels 18 by 2, 20 by 2, 24 by 3 and 30 by 3 inches, respectively.

CUTLER-HAMMER MOTOR STARTERS

An automatic across-the-line starter intended for use in general applications of direct-current motors up to 2 horsepower, 115 or 230 volts, is being introduced to the trade by Cutler-Hammer, Inc., 1203 St. Paul Ave., Milwaukee, Wis. Two magnetic contactors, one in each side of the line, connect the motor directly across the line in starting, and provide a double line break. These contactors are designed especially for direct-current service, and have renewable silver contacts.

The thermal overload relays provided are the same as those employed in alternating-current across-the-line starters made by the same concern for small motors. They are of the fusible alloy type, and can be adapted to different sizes of motors by simply changing the heater coils. When tripped by an overload, the relays are reset by pushing a button in the cover. Low-voltage protection is also provided. A push-button master switch, providing a three-wire control, can be mounted in the cover of the starter or separately.

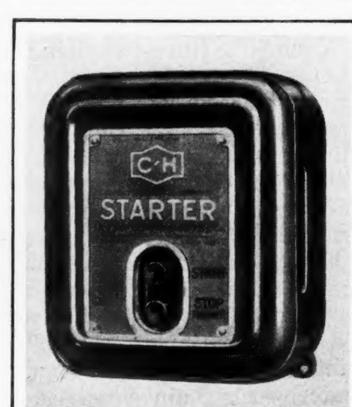


Fig. 1. Cutler-Hammer Across-the-Line Starter

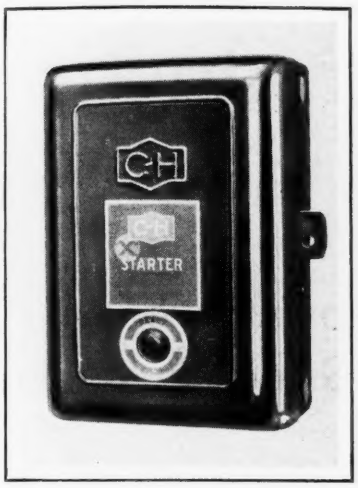


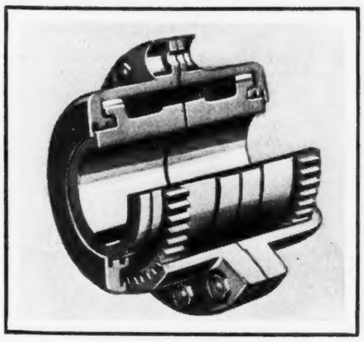
Fig. 2. Direct-current Counter Electromotive Force Starter

This starter, which is shown in Fig. 1, is also made without the thermal overload relays.

Fig. 2 shows a counter electromotive force type automatic starter which is also designed for direct-current motors up to 2 horsepower, operating on 115 or 230 volts. When the "start" button of the master switch is depressed, the main line contactor connects the motor to the line through the armature resister. As the motor is accelerated to the proper point, the counter electromotive force of the motor armature closes the accelerating contactor, which cuts out the armature resister and connects the motor across the line.

POOLE IMPROVED FLEXIBLE COUPLINGS

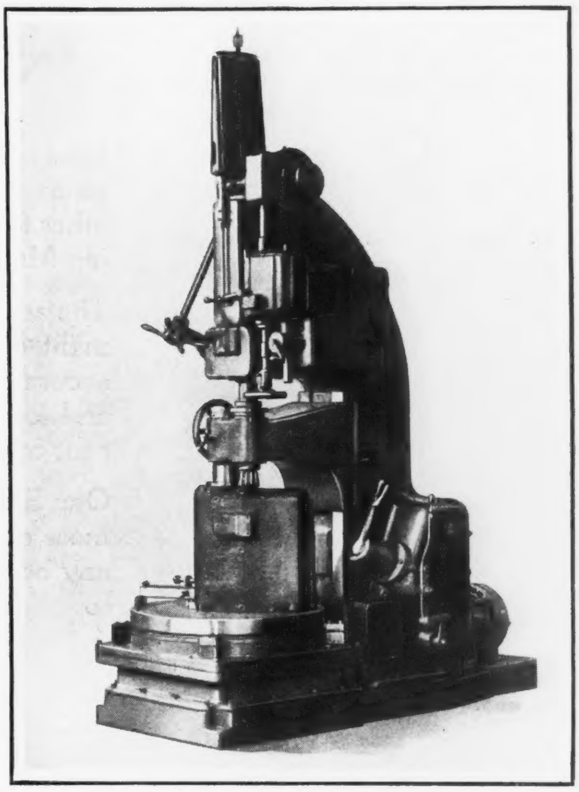
Centrifugal oiling by means of a dustproof arrangement is an important improvement recently incorporated in the flexible couplings manufactured by the Poole Engineering & Machine Co., Baltimore, Md. This oiling feature has been obtained by means of a new type of double flanged end plate which contains within its inner lips deep felt packing for excluding dust and dirt. The outer section of the couplings contains back-drain oil-holes which permit the couplings to be lubricated while they are in motion. An improved coupling is shown in the accompanying illustration, while the former construction was shown in January, 1926, MACHINERY, page 418.



Poole Flexible Coupling with Centrifugal Oiling Feature

When the couplings are running, oil spreads around the inner circumference, submerging all teeth and bearing surfaces and, due to centrifugal pressure, maintaining an oil film to cushion shocks and prevent wear. The felt packing rings which exclude dust and dirt allow flexibility.

The couplings are self-aligning, with no binding action at any point of their revolution. The floating sleeves are supported on crowned teeth and are free to align themselves as ball-and-socket joints. Various sizes and types are made to meet a large range of requirements.



Defiance Machine Built Primarily for Face-milling Automobile Crankcases

DEFIANCE DRILLING, BORING, AND VERTICAL MILLING MACHINE

The machine here illustrated has been designed by the Defiance Machine Works, Defiance, Ohio, for face-milling around the large bore of crankcases, as well as for performing standard drilling, boring, reaming, and tapping operations. The head and feed- and speed-boxes of this machine are fully enclosed, and provided with a gravity or continuous-flow oiling system.

A single-pulley drive is provided, different spindle speeds being obtained through two cones of gears which run idle except when one set is meshed with a gear by operating a lever at the side of the machine. Helical gears are used to drive the spindle close to its nose.

The machine is equipped with a 36-inch revolving table which is power fed through worm-gearing driven by a two-horsepower motor running at 1750 revolutions per minute. The machine proper is driven by a 7 1/2-horsepower motor running at 1200 revolutions per minute. The net weight is approximately 8800 pounds. The maximum distance between spindle nose and table top is 41 inches. Plain or compound tables and a tapping attachment can be supplied.

NEW methods production savings ~

with the Brown & Sharpe No. 30 Plain Grinding Machine

New achievements are being established daily in the automotive, electrical, machine tool manufacturing, and many other fields with the Brown & Sharpe No. 30 Plain Grinding Machine.

The advanced design of the machine enables the development of new methods which increase the production of accurate work, reduce the effort required of the operator, and lead the way to substantial new savings. Some recent applications are shown at the right.

Our Engineering Service is ready to help you make the most of the many production features of the No. 30, or any other size in the "30 series." Ask our representative to tell you more about them.

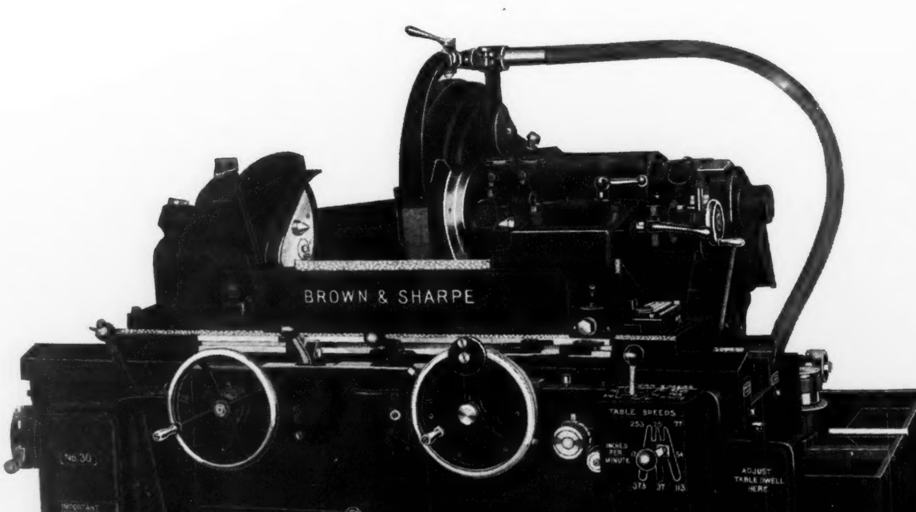
The "30 series"
BROWN & SHARPE PLAIN GRINDING MACHINES

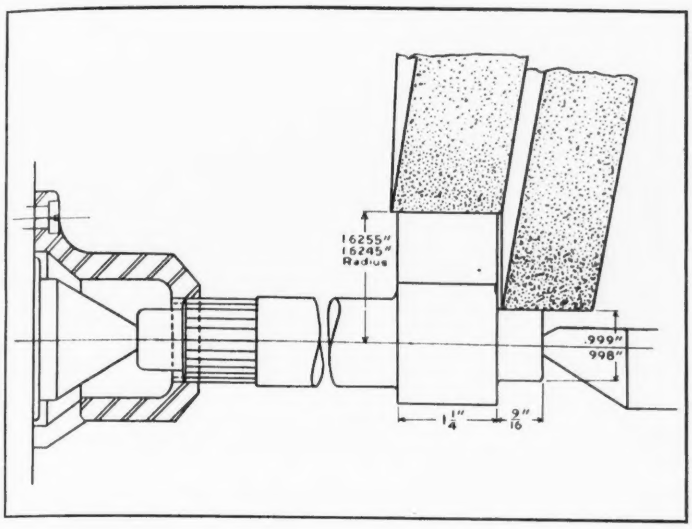
No. 30	No. 32
No. 33	No. 35

MODIFIED MACHINES

Nos. 30A, 32A, and 33A
(Power Table Feed for Wheel Truing, and Power Cross Feed)

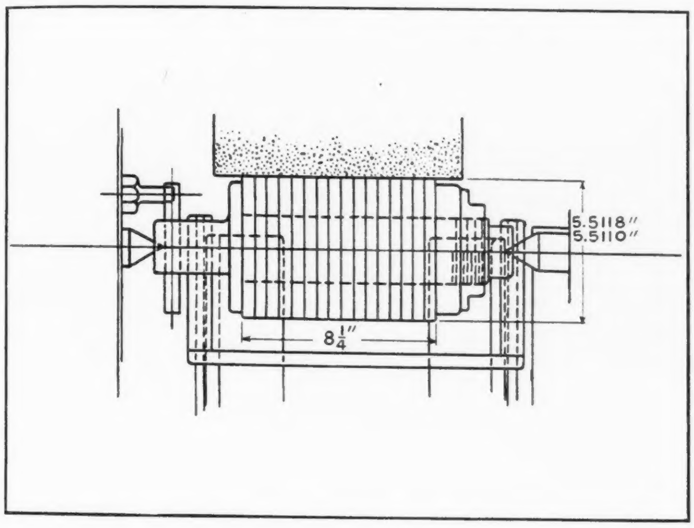
Nos. 30B, 32B, and 33B
(Hand Table and Cross Feeds)





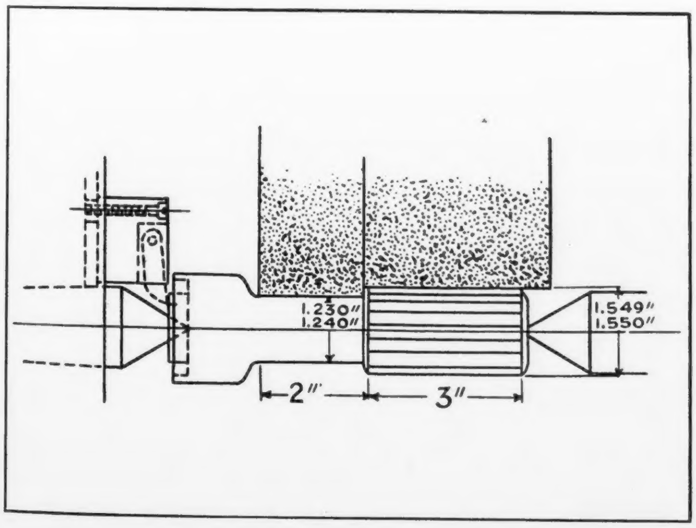
Machine	No. 30A Plain Grinding Machine
Part	Shock Absorber Vane Shaft
Material	Heat-treated Steel
Operation	Grind Short End and Vane
Stock Removed	.010" to .018" on Diameter
Special Equipment	2 Wheels, Serrated Work Driver, Truing Device, Wheel Sleeve, Spacer and Wheel Flange
Time per Piece	29 seconds

Repeat orders have been received for No. 30 Brown & Sharpe Plain Grinding Machines from four factories making shock absorber vane shafts.



Machine	No. 30 Plain Grinding Machine
Part	Ball Bearing Rings
Material	Hardened Steel
Operation	Grind Outside Diameter
Stock Removed	.012" on Diameter
Special Equipment	Work Cradle and Two Gang Arbors
Time per Piece	7.5 seconds

The high finish demanded on these pieces was easily obtained on the Brown & Sharpe No. 30 Plain Grinding Machine.

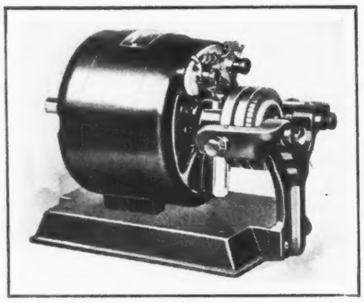


Machine	No. 30B Plain Grinding Machine
Part	Stub Shaft
Material	Heat-treated Carbon Steel
Operation	Grind Two Diameters
Stock Removed	.025" to .030" on Diameter
Special Equipment	Truing Device and Work Driver
Time per Piece	26 seconds

The capacity of the No. 30 for rapid stock removal is clearly demonstrated in this and many other straight-in-feed jobs.

BROWN & SHARPE

BROWN & SHARPE MFG. CO. — PROVIDENCE, R. I., U. S. A.



Bodine Device for Converting Direct Current into Alternating Current

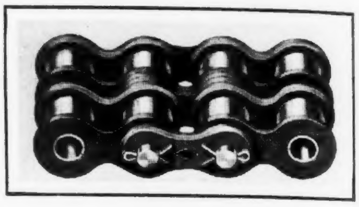
BODINE MOTOR-DRIVEN POLE CHANGER

The Bodine Electric Co., 2254 W. Ohio St., Chicago, Ill., manufacturer of fractional-horsepower alternating- and direct-current motors and generators, has recently developed a motor-driven contact maker for converting direct current into alternating current. This is done by reversing the direct current through a special commutator. Direct current is fed to the commutator through a pair of slip rings, and the output is taken from brushes in contact with the commutator. The motor can be wound for any voltage of alternating or direct current.

DIAMOND LARGE-SIZE ROLLER CHAIN

A roller chain of 2 1/2 inches pitch has recently been brought out by the Diamond Chain & Mfg. Co., 409 Kentucky Ave., Indianapolis, Ind., for heavy-duty applications, such as on large conveyors, industrial locomotives, etc.

As may be seen by reference to the illustration, this chain is similar in design to all roller chain made by the company, and conforms to A.S.M.E., S.A.E., A.G.M.A., and American Standards. It is made in single and multiple strands, the transmission capacity and tensile strength being proportional to the number of strands. The single-strand chain has an average tensile strength of 95,000 pounds, and a rating of 97 horsepower, with a 19-tooth sprocket.



Diamond Roller Chain of 2 1/2 Inches Pitch

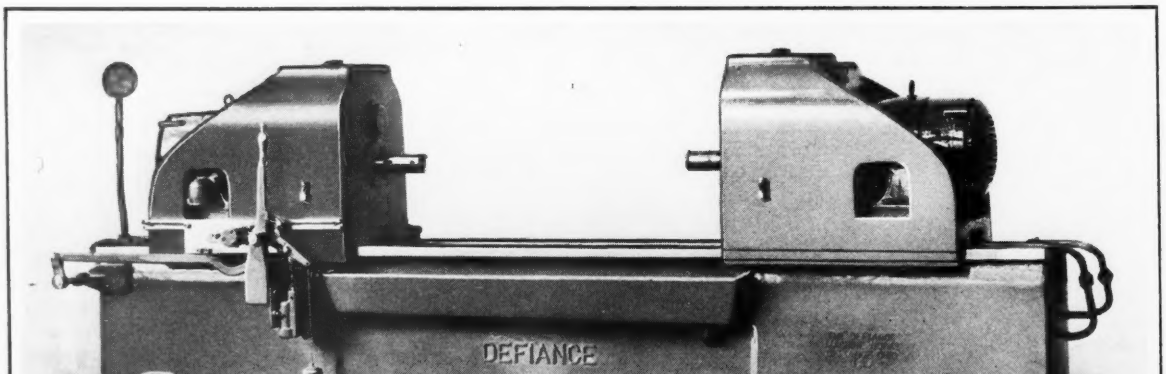
DEFIANCE TWO-WAY HORIZONTAL BORING AND REAMING MACHINE

The two-way opposed-spindle horizontal boring and reaming machine shown in the accompanying illustration has recently been built by the Defiance Machine Works, Defiance, Ohio, to be used in producing parts for automobiles, gas engines, tractors, transmission cases, and similar work. It is designed for performing boring and reaming operations or for use as a power unit to drive multiple-spindle drill heads, etc. The two heads slide on ways which are planed the entire length of the base so that the work-holding fixture can be accurately mounted on the base.

The machine, as shown, was built with single-spindle heads, but heads can be supplied with any number of spindles to suit requirements, and with spindles of any diameter. The length of the bed and the height of the spindle centers can also be made to suit the work. The heads are completely enclosed and are provided with splash or force-feed lubrication.

An Oilgear hydraulic feed can be furnished or a mechanical feed having a rapid power approach to the work, then a feeding movement at the desired rate, with a dwell for a facing operation if desired, and finally a rapid return movement. The heads are driven by motors attached to the drive spindles.

On the particular machine illustrated, the minimum distance between the spindle noses is 29 1/2 inches, and the maximum distance, 57 1/2 inches. The height from the top of the ways to the spindle centers is 12 inches. The net weight is approximately 9700 pounds.



Defiance Opposed-spindle Horizontal Boring and Reaming Machine

OBITUARIES

HENRY A. COLES, Atlanta district manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., died recently in New Orleans, La., of heart failure. Mr. Coles was born in Tallwood, Albemarle County, Va., on August 17, 1870. He took an engineering course at the University of Virginia, and following his graduation in 1891, he spent six months operating an electric plant in Charlottesville, Va. He then entered the employ of the Edison General Electric Co. Leaving there, he became connected with the Westinghouse organization. In June, 1897, he was transferred to the sales department and stationed in Atlanta. In 1911 he was made manager of the Railway and Lighting Division at Atlanta, and in September, 1914, was appointed district manager.

ALEXANDER L. SCHUHL, manager of the Philadelphia office of the Independent Pneumatic Tool Co., Chicago, Ill., died of pneumonia on October 20, after an illness of only a few days. Mr. Schuhl was born in Philadelphia on May 25, 1884. Upon completing school, he entered the service of Wm. Cramp & Sons, Ship and Engine Building Co. as a machinist apprentice, and worked there until he became foreman of the pneumatic tool-room. In 1917 he resigned that position and joined the sales organization of the Independent Pneumatic Tool Co. He was appointed manager of the Philadelphia office in 1924.

THOMAS A. CARROLL, advertising manager for E. C. Atkins & Co., Indianapolis, Ind., for the last sixteen years, died on November 18 at the Methodist Hospital in Indianapolis, following a sudden illness. Mr. Carroll was born in Beaver Falls, Pa., fifty-one years ago. His business association in Beaver Falls was with Emerson, Smith & Co., saw manufacturers. In 1913, he went to Indianapolis and became associated with E. C. Atkins & Co.

PERSONALS

GORDON THORNTON has been added to the Cleveland staff of the United States Electrical Tool Co., 2477 W. Sixth St., Cincinnati, Ohio.

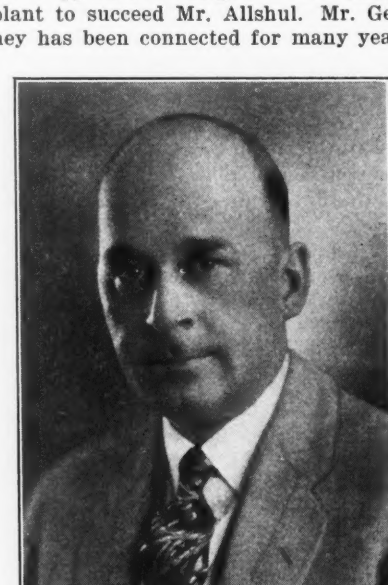
CHARLES LE GEYT FORTESCUE, chief consulting transmission engineer for the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has received the honorary degree of Doctor of Laws from Queens University in recognition of his outstanding work in the field of electrical transmission engineering.

D. O. REARDON is now representing the Wagner Electric Corporation, 6400 Plymouth Ave., St. Louis, Mo., in sixty-four counties in Iowa, with headquarters in Des Moines. For the last seven years, Mr. Reardon has been Iowa representative for the Merchandising Division of the Westinghouse Electric & Mfg. Co.

THOMAS FULLER, formerly manager of the Charlotte, N. C., office of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has been appointed manager of the Atlanta district office to fill the vacancy caused by the death of H. A. Coles. Mr. Fuller has been connected with the Westinghouse organization since 1906.

ARTHUR C. ALLSHUL, formerly manager of the Buffalo plant of Joseph T. Ryerson & Son, Inc., Chicago, Ill., has been appointed manager of the Philadelphia branch. CLARENCE S. GEDNEY has been appointed manager of the Buffalo plant to succeed Mr. Allshul. Mr. Gedney has been connected for many years with the specialty sales division of the Ryerson business in Chicago.

Arthur C. Allshul, Manager, Philadelphia Branch of Joseph T. Ryerson & Son, Inc.



Clarence S. Gedney, Manager, Buffalo Plant of Joseph T. Ryerson & Son, Inc.

RALPH H. CLORE has been appointed general sales manager of the United States Electrical Tool Co., Cincinnati, Ohio. Mr. Clore succeeds GEORGE M. LAWRENCE, who, after a number of years as branch manager and general sales manager, has resigned to become vice-president of the General Radial Drill Co., Cincinnati.

FRANK DUSTAN and O. B. SCHMELTZ, sales engineers, formerly located at the Putnam Machine Works, Fitchburg, Mass., have been transferred to Pittsburgh to assist the Arch Machinery Co. in representing the Putnam machine tools of Manning, Maxwell & Moore, Inc. Mr. Dustan and Mr. Schmeltz will be located at Manning, Maxwell & Moore's offices, Park Building, Pittsburgh, Pa.

JOSEPH P. FLETCHER, manager of the Buffalo office of the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill., has been appointed manager of the Philadelphia office to succeed the late A. L. Schuhl. W. O. BECKER, who was connected with the Toronto office, will take Mr. Fletcher's place as manager of the Buffalo office.

FRANK A. WEIDMAN has been appointed manager of the wrought iron division of the Sharon Steel Hoop Co., Sharon, Pa., and will have charge of the development and distribution of wrought-iron sheets made by the new Aston-Byers process. Mr. Weidman was, until recently, special representative for the Inland Steel Co. of Chicago. Previous to that he was with the American Sheet & Tin Plate Co. at Pittsburgh.

R. L. COLLIER has been made assistant to Granville P. Rogers, managing director of the Steel Founders' Society of America. Mr. Collier is a graduate of Ohio State University. For some time he conducted special work for a public utility company at Cleveland, and for the last three years has been engaged in trade organization work in the electrical field. He will be located at the executive offices of the society, 932 Graybar Building, New York City.

A. T. NOGRADY has been appointed representative of the Autosan Machine Division of Colt's Patent Fire Arms Mfg. Co., Hartford, Conn., for the New York territory. Mr. Nogrady will cover, in addition to New York City, parts of New York state and the Philadelphia, Washington, and Baltimore districts. RUSSELL CHICO will be associated with Mr. Nogrady in covering the New York territory, and both will work from the New York office at 20 Vesey St.

EDWARD B. NEWILL, formerly manager of the control engineering department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has become affiliated in an executive capacity with the radio manufacturing company being formed jointly by the General Motors Corporation and the Radio Corporation of America. Mr. Newill entered on his new duties October 16 under the title of assistant to the president of Delco Products Co., with temporary headquarters at Dayton, Ohio. When the organization of the new radio company is consummated, he will be assigned executive duties in connection with either engineering or manufacturing.

TRADE NOTES

CONWAY CLUTCH Co., 1962 W. 6th St., Cincinnati, Ohio, is moving its plant to larger quarters at 1543 Queen City Ave.

HERBERTS-MOORE MACHINERY Co., 140 First St., San Francisco, Calif., will handle the sale of South Bend lathes in northern California and Nevada.

GARDNER-DENVER Co., manufacturer of pumps, air compressors, rock drills, drill sharpeners, and high-pressure drill steel forges, is constructing an addition to its plant at Quincy, Ill.

DIAMOND CHAIN & MFG. Co., 409 Kentucky Ave., Indianapolis, Ind., has appointed L. A. Benson & Co. of Baltimore, Md., distributor for Diamond roller chain in that territory.

TIME-O-STAT CONTROLS Co., Elkhart, Ind., is completing a new plant that will make available 79,000 additional square feet of space. This company manufactures heat regulating devices.

READING CHAIN & BLOCK CORPORATION, Reading, Pa., has appointed the Murry Jacobs Co., 554 S. Pedro St., Los Angeles, Calif., representative of the company in Southern California. Harry T. Lynam will have charge of the Los Angeles office.

KORFUND Co., INC., 235 E. 42nd St., New York City, is issuing a quarterly publication called "Isolation," which is devoted to the scientific, practical, and economic application of materials and methods for deadening and eliminating vibration and noise.

CHAIN BELT Co., Milwaukee, Wis., has opened a New England district office in Boston, Mass., at 950 Park Square Building. This is the eighteenth district office that has been opened in the United States within a comparatively few years. J. K. Merwin is district manager.

WAGNER ELECTRIC CORPORATION, 6400 Plymouth Ave., St. Louis, Mo., has removed its Milwaukee sales office and service station from 501 Broadway to 525-27 Broadway. The St. Louis sales office has been moved from 505 Shell Building to 909 Plaza Olive Building.

WESTINGHOUSE LAMP Co., East Pittsburgh, Pa., has placed a contract with the White Construction Co., Inc., for the erection of a manufacturing plant at Bloomfield, N. J. The new factory will be a five-story structure, of reinforced concrete, covering a plot 200 by 80 feet.

JOSEPH T. RYERSON & SON, INC., 16th and Rockwell Sts., Chicago, Ill., have purchased the business, equipment, and stock of the PENN-JERSEY STEEL Co., Camden, N. J. This firm carries complete stocks of steel shapes, plates, sheets, hot- and cold-finished bars, reinforcing bars, etc.

MANCO MFG Co., Bradley, Ill., manufacturer of woodworking machinery, is enlarging its plant and installing heating and ventilating equipment, as well as additional machinery. The new buildings will be of brick, steel, and glass construction and will afford about 10,000 additional square feet of capacity.

STERLING GRINDING WHEEL Co., Tiffin, Ohio, announces a program of expansion to extend over a period of six months. It is planned to construct a building giving 18,000 square feet of additional floor space, and another of the same size as soon as the first is completed. A large amount of new machinery is to be purchased.

CUTLER-HAMMER, INC., 1203 St. Paul Ave., Milwaukee, Wis., announces that the St. Louis district sales office of the company has been moved from 611 Olive St. to 1914 Washington Ave. A new warehouse has been established at the same address, where a stock of standard CH motor control and wiring devices will be carried for immediate delivery.

STEAM & COMBUSTION Co., 205 W. Wacker Drive, Chicago, Ill., has been incorporated to manufacture gas-fired boilers and kindred lines. The company is owned and operated by the G. W. Dulany Trust of Chicago. The officers are C. B. Page, president; W. E. Eberhardt, vice-president and treasurer; and James E. Moore, secretary and assistant treasurer.

GEARS & FORGINGS, INC., 3122 Woodhill Road, Cleveland, Ohio, have recently acquired a new plant for their Chicago operations. The new factory is in two units, and affords between 30,000 and 40,000 square feet of manufacturing space. It is located at 2108-2120 N. Natchez Ave., Chicago. The Chicago branch office will be located at the new plant, where C. F. Goedke, Chicago district sales manager, will have his headquarters.

HENRY & WRIGHT MFG. Co., Hartford, Conn., manufacturer of the Henry & Wright dieing machine, announces that a controlling interest in the concern has been purchased by executives connected with Stone & Webster of Boston, Mass. At a recent meeting, the following officers and directors were elected: Chairman of board, C. J. Sorrells; president, J. F. Funk; vice-president, W. J. Henry; treasurer, F. H. Farnham; and secretary, D. C. Jewett.

WESTCOTT CHUCK Co., 116 Walnut St., Oneida, N. Y., announces the appointment of the following representatives: G. L. Hunt, Philadelphia Bourse Building, Philadelphia, Pa.; Noxsel-Stroman Co., 14 E. Tupper St., Buffalo, N. Y.; S. A. Dinsmore, 327 S. LaSalle St., Chicago, Ill.; K. D. Carlson Co., Box 397 Arcade Station, Los Angeles, Calif., and 268 Market St., San Francisco, Calif.; F. A. O'Donnell, 1509 First National Bank Building, Pittsburgh, Pa.

EX-CELL-O AIRCRAFT & TOOL CORPORATION, 1238 Oakman Blvd., Detroit, Mich., manufacturer of Ex-Cell-O drill jig bushings, internal grinding spindles, and aircraft and Diesel engine parts, announces the acquisition of the GOVRO-NELSON Co., manufacturer of aircraft engine parts. The manufacturing facilities of the Govro-Nelson Co., together with the now almost completed addition to the Ex-Cell-O plant, will more than double the manufacturing capacity of the Ex-Cell-O Aircraft & Tool Corporation.

SAMSON-UNITED CORPORATION, which recently absorbed the business of the Samson Cutlery Co., has purchased one of the largest plants in Rochester, N. Y., formerly occupied by the Selden Truck Co. The building covers an area of about 6 1/2 acres and has a floor space of 200,000 square feet. The new plant will be equipped with labor-saving equipment for straight-line production and will employ over 500 people. It will be devoted to the manufacture of this company's line of electrical appliances and stainless steel cutlery.

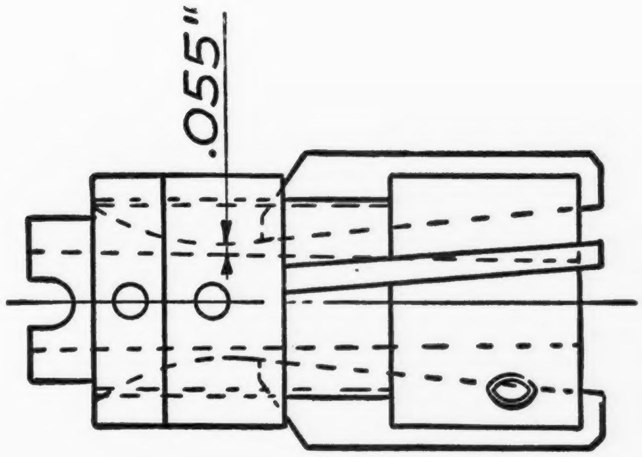
THOMSON ELECTRIC WELDING Co., Lynn, Mass., and the GIBB WELDING MACHINES Co., Bay City, Mich., announce a consolidation of the two companies, which will hereafter be known as the THOMSON-GIBB ELECTRIC WELDING Co. Both plants will continue in operation. The new company will offer a full line of butt, flash, seam, spot, projection and wire fabric welders, together with expert service designed to secure uninterrupted production and uniform quality from its machines in the hands of manufacturers. For this purpose local service engineers will be established at various points.

STANLEY ELECTRIC TOOL Co., a subsidiary of the Stanley Works, New Britain, Conn., has purchased the trade name, stock on hand, tools, jigs, fixtures, etc. of the UNISHEAR Co., 270 Lafayette St., New York City and will continue manufacture and development at its main plant in New Britain. The line comprises motor-powered shears for outside and inside cutting of sheet material of every description. The Stanley Electric Tool Co. has also purchased the business of the AJAX HAMMER CORPORATION, 117 W. 63rd St., New York City, which consists of a line of electric hammers used extensively for construction and maintenance work.

* * *

Recording the riding qualities of automobiles may soon become practicable through the use of the "gyro-accelerometer." The development of this instrument came as a result of research into the riding quality of automobiles, which demonstrated the necessity of measuring angular motions in a moving car under road conditions. To avoid taking a great number of readings and to obtain a basis of comparison, a standard test, consisting of driving a car over a special bump at different speeds and plotting curves of the resulting angular quantities as given by the gyro-accelerometer, was devised. This test is known as the standard bump test.

The results of tests made by this method indicate the close relationship between riding quality and angular acceleration, or speed of motion around a point in the car. This relationship allows riding quality to be evaluated numerically so that cars of different makes tested at different times and localities can be tabulated as to riding quality without making direct comparison.



The thickness of the wall between the hole and the bottom of the blade slot is .055" in this small Wetmore Shell Reamer. In larger sizes where more strength is required, the thickness of the wall is greater.

Why WETMORE REAMERS *are strong where ordinary reamers are weak—*

You Wouldn't Choose the Doughnut that has the largest hole!

You can't eat the hole—it's the sidewall you want. The larger the hole, the "weaker" the doughnut.

What you want is ample sidewall for more "strength", and not too much hole. It's a far cry from doughnuts to reamers, but you see the point.

JUST as a chain is no stronger than its weakest link — A reamer is no stronger than *its* weakest section.

Study the drawing of a Wetmore Shell Reamer shown above. Note that this reamer is designed with a hole of ample size to give the reamer sufficient strength and at the same time to secure the maximum amount of adjustment oversize.

The thinner the wall, the weaker the reamer. If the wall is built too light in order to obtain a large hole through the reamer, the angle for oversize adjustment is decreased, thereby cutting down the amount of oversize adjustment possible.

Sounds technical perhaps, but when you think about it, it's perfectly obvious. And it proves that Wetmore Reamers are scientifically built to give greatest satisfaction — strength that means long life without grief, maximum possible oversize adjustment that means greater adaptability.

Send now for Wetmore Catalog No. 29, for full information about Wetmore standard, heavy-duty, shell, small machine, and cylinder reamers, arbors, and replacement blades. Sent free, postpaid.

WETMORE REAMER COMPANY
60 27th Street Milwaukee, Wisconsin

WETMORE ADJUSTABLE REAMERS
"THE BETTER REAMER"

COMING EVENTS

DECEMBER 2-6—Annual meeting of the American Society of Mechanical Engineers at the Engineering Societies Building, 29 W. 39th St., New York City. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

DECEMBER 2-6—National Exposition of Power and Mechanical Engineering in the Grand Central Palace, New York City. Charles F. Roth and Fred W. Payne, managers, Grand Central Palace, New York City.

DECEMBER 4—Annual meeting of the Power Transmission Association at the Hotel Commodore, New York City. Further information can be obtained from the headquarters of the association, Drexel Bldg., Philadelphia, Pa.

DECEMBER 12—Regular meeting of the Steel Founders' Society of America in Pittsburgh, Pa. G. P. Rogers, managing director, 932 Graybar Building, New York City.

FEBRUARY 7-8—Semi-annual meeting of the American Society for Steel Treating in New York City; headquarters, Hotel Pennsylvania. Secretary, W. H. Eisenman, 7016 Euclid Ave., Cleveland, Ohio.

SOCIETIES, SCHOOLS AND COLLEGES

WORCESTER POLYTECHNIC INSTITUTE, Worcester, Mass. Annual catalogue for 1929-1930, containing calendar, courses of study, etc.

AMERICAN INSTITUTE OF WEIGHTS AND MEASURES, 33 Rector St., New York City. Chart of weights and measures, including both English and metric units. The fundamental purpose of the chart is to furnish a source of reference for units that may be required occasionally but that are not quite so familiar as the everyday ones. The chart is distributed without charge to those interested.

NEW BOOKS AND PAMPHLETS

WORKMEN'S SAFETY COMMITTEES. 16 pages, 5 1/2 by 7 1/2 inches. Published by the Metropolitan Life Insurance Co., 1 Madison Ave., New York City, as Industrial Safety Pamphlet No. 5 of the Policyholders' Service Bureau.

AN INVESTIGATION OF THE FAILURE OF FLAME-CUT WIND-BRACING BRACKETS. By William J. Krefeld. 133 pages, 6 by 9 inches. Published by Columbia University, New York City, as Bulletin No. 3 of the Department of Civil Engineering.

TUNING OF OSCILLATING CIRCUITS BY PLATE CURRENT VARIATIONS. By J. Tykocinski Tykociner and Ralph W. Armstrong. 51 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 194 of the Engineering Experiment Station. Price, 30 cents.

A.S.T.M. TENTATIVE STANDARDS (1929). 901 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Price, paper-bound $7; cloth-bound, $8.

This book contains proposed standards covering ferrous and non-ferrous metals; cement, lime, gypsum, and clay products; preservative coatings and petroleum products; road and paving materials; rubber products, insulating materials, and textile materials; coal and coke; shipping containers; slate; and miscellaneous materials.

BLUEPRINT READING. By Joseph Brahdy. 199 pages, 6 by 9 inches. Published by the McGraw-Hill Book Co., Inc., 370 Seventh Ave., New York City. Price, $2.

This is the second edition of a book on blueprint reading, the aim of which is to enable the student to read the drawings on commercial blueprints. When the book was first written the author intended the text to meet the special needs of machinists. However, the distribution indicated that the text meets the needs of those who, having entered an industry, desire to round out in evening school or corporation school classes their vocational training, as well as of students in secondary schools where systematic courses in blueprint reading are given. The text has been thoroughly revised and brought up to date.

FORD MODEL A CAR. By Victor W. Page. 545 pages, 5 by 7½ inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $2.

Mr. Page's books on automotive subjects, and especially on the Ford car, are well known to all interested in automobile construction and repair. Bringing his works up to date, the present book treats of the construction, operation, and repair of the new Ford Model A car. All parts of these cars are described in a comprehensive manner, and the text is illustrated by about 300 specially made drawings and photographs. The construction is treated in detail and operating principles are simply and clearly described. Complete instructions for driving and repairing are included. The chapter on location and remedy of common troubles should be of special value. The author has had the cooperation of the service department of the Ford Motor Co. in preparing this material. This book should be a valuable guide to all owners or drivers of the new Ford car, as well as to dealers, salesmen, repairmen and mechanics.

MODERN AVIATION ENGINES. By Victor W. Page. Published in two volumes containing 2000 pages, 6 1/4 by 9 1/4 inches; 1000 illustrations, 50 tables. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $9, net; volumes sold separately, $5 each.

What seems to be the most comprehensive work on aviation engines yet published has been brought out after more than five years of preparation by the author, with the assistance of leading airplane and engine manufacturers, as well as the United States Army and Navy Air Services. These volumes contain forty-six chapters describing the leading American, English, French, German, and Italian aeronautical engines. The work covers all the principles of engine operation, elementary thermodynamics, design and materials of construction of all engine parts, and their relation in the assembly. It points out why certain constructions are favored, and shows principles of engine action by specially prepared diagrams, charts, and photographs. It describes the installation, service, and repair of airplane engines, and tells how they are tested on the field and operated in flight.

THOMAS' REGISTER OF AMERICAN MANUFACTURERS (1929-1930). 4500 pages, 9 by 12 inches. Published by the Thomas Publishing Co., 461 Eighth Ave., New York City. Price, $15.

Buyers in all lines of manufacture will welcome the 1929 edition of this well-known register of American manufacturers. For the benefit of those who are not familiar with this work, it may be stated that this is a purchasing guide that aims to list all American manufacturers and primary sources of supply. The new edition has been completely revised and brought up to date. The book contains four sections as in previous editions, the first comprising a finding list or index of products. The second section, which forms the principal part of the book, contains a list of manufacturers classified according to business. This section covers 3549 pages. Next follows an alphabetical list of manufacturers, giving home offices, branches, affiliations, succeeding concerns, cable addresses, etc. The fourth section comprises an alphabetical list of the leading trade names and brands. An appendix is included, covering banks, boards of trade and other commercial organizations, and leading trade papers. The various sections are printed on different colored paper so that they may be easily referred to.

NEW CATALOGUES AND CIRCULARS

GAS-FIRED BOILERS. Steam & Combustion Co., 205 W. Wacker Drive, Chicago, Ill. Circular illustrating and describing automatic gas-fired high-pressure boilers.

ELECTRIC MOTORS. Century Electric Co., 1806 Pine St., St. Louis, Mo. Bulletin 13-1 for loose-leaf catalogue, covering Century Type SC squirrel-cage induction polyphase motors.

MILLING MACHINES. Kearney & Trecker Corporation, Milwaukee, Wis. Circular illustrating the exhibit of Milwaukee milling machines at the Cleveland Machine Tool Exposition.

STEEL SHOP EQUIPMENT. Standard Pressed Steel Co., Jenkintown, Pa. Bulletin illustrating standard and special Hallowell steel shop equipment, including desks and workbenches.

ELECTRIC FITTINGS. Crouse-Hinds Co., Syracuse, N. Y. General catalogue 2200, covering the complete line of Crouse-Hinds products, which includes condulets, groundulets, plugs, and receptacles.

DRILLING AND CENTERING MACHINES. Sundstrand Machine Tool Co., Rockford, Ill. Bulletin illustrating and describing Sundstrand motor-driven double-end drilling and centering machines.

STEEL PRODUCTS. United States Steel Corporation, New York City. Catalogue covering the products and publications of the subsidiary manufacturing companies of the United States Steel Corporation.

WIRE-FORMING MACHINERY. Baird Machine Co., Bridgeport, Conn. Circular illustrating Baird four-slide wire-forming machine, tilting tumbler, ball burnishing barrel, chucking machine, and automatic press.

SHEET-METAL WORKING MACHINES. Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y. Booklet illustrating Niagara machines and tools for sheet-metal working applied to aircraft manufacture.

REAMERS AND TOOL-HOLDERS. W. C. Lipe, Inc., 208 S. Geddes St., Syracuse, N. Y. Loose-leaf catalogue covering the line of burring fixtures, taper reamers, lathe arbors, tool-holders, and boring-bars made by this concern.

ELECTRIC MOTORS. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Folder entitled "Machine Tools Powered by Westinghouse," showing twenty-eight different types of machine tools provided with Westinghouse motors.

INSERTED-BLADE MILLING CUTTERS. Goddard & Goddard Co., Detroit, Mich. Bulletin 101, descriptive of the series W line of inserted serrated blade milling cutters. Dimensions and prices of the various sizes are included.

BRAKE-DRUM LATHES. Sundstrand Machine Tool Co., Rockford, Ill. Circular giving specifications covering the Sundstrand brake-drum stub lathe designed for turning automobile brake drums after they have been attached to the wheels.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Catalogue descriptive of New Departure N-D-Seal ball bearings for electric motors, small pumps, vacuum cleaners, portable electric or air-driven tools, etc. Tables of dimensions, tolerances, and load ratings are included.

AJAX

For The Commercial Forge Shop

WHERE wide range and dependability are determining factors, Ajax Heavy Duty Forging Machines are the logical choice.

Wide range because of liberal die space and abundant power for the heaviest jobs and ease of operation and speed for the lighter ones.

Dependability because of the fundamental soundness and simplicity of Ajax design coupled with extreme ruggedness of working parts.

These are the factors which are maintaining Ajax predominance in the Commercial Forge Shops.

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New York, N. Y.

CENTERLESS GRINDERS. Cincinnati Grinders, Incorporated, Cincinnati, Ohio. Booklet illustrating and describing the Nos. 3 and 4 Cincinnati centerless grinding machines. In addition to giving complete descriptions, the book shows many views of these machines in operation on actual jobs.

MOTORS. Louis Allis Co., Milwaukee, Wis. Bulletin 508, illustrating and describing Louis Allis "Explosion-proof," self-ventilated, squirrel-cage motors. The bulletin illustrates applications of these motors in various hazardous industries where power is used in explosive atmospheres.

ZINC DIE-CASTINGS. New Jersey Zinc Co., 160 Front St., New York City. Pamphlet illustrating a large variety of die-castings made from "Horse Head" zinc. Information is included relative to the economies that may be effected by the use of this process in producing parts of the type illustrated.

WELDING EQUIPMENT. Fusion Welding Corporation, 103rd St. and Torrence Ave., Chicago, Ill. Bulletin 4, descriptive of the "Weldite" Type S welding rod for welding chrome-nickel and similar alloy steels that resist corrosion and high temperatures. Complete instructions on the use of this rod are included.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Leaflets GEA-104A, 704B, 834A, 948A, 1006B, and 1162, treating, respectively, of cartridge type electric heating units, oil circuit breakers, controllers for alternating-current motors, controllers for constant-speed motors, concentrated system control, and pressure governors.

WELDING EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletins GEA-556C and 569C, illustrating and describing, respectively, the GE automatic welding head and control, and constant-potential arc-welding sets. Bulletin 13-C-2, containing an article relating to the application of welding in the fabricating of steel bridges and buildings.

GEARS. Westinghouse Electric & Mfg. Co., Nuttall Works, East Pittsburgh, Pa. Folder 5223 entitled "It Pays to Use Westinghouse Nuttall Heat-treated and Hardened Gears." The circular gives facts about heat-treated gears and their use, and contains a complete description of both the BP "tough-hard" and the EP processes used in heat-treating Westinghouse-Nuttall gears.

ELECTRIC CONTROLLING APPARATUS. Allen-Bradley Co., 499 Clinton St., Milwaukee, Wis. Loose-leaf catalogue covering the Allen-Bradley line of electric controlling apparatus, including starters, controllers, rheostats, battery charging and testing equipment, and accessories. The catalogue is provided with a thumb index so that the various subjects can be readily located.

PRESS BRAKES. Cincinnati Shaper Co., Elam St. and Garrard Ave., Cincinnati, Ohio. Loose-leaf catalogue illustrating and describing the complete line of Cincinnati all-steel press brakes. In addition to showing the different types of machines, typical examples of work performed with these press brakes are illustrated. Data and specification sheets covering the various sizes are also included.

SHAPERS. Cincinnati Shaper Co., Cincinnati, Ohio. Twenty-eight-page catalogue illustrating and describing the Cincinnati line of shapers. The first half of the book illustrates typical models and sizes taken from the entire line of twenty-two shapers. The last half comprises a treatise on modern shaper design. The machines are reproduced in three colors. Copies of the catalogue will be sent to those interested upon request.

DIE-HEADS AND SCREW MACHINE PRODUCTS. Eastern Machine Screw Corporation, New Haven, Conn., is issuing a threaded part data book prepared to assist designers, engineers, and draftsmen, as well as manufacturing departments, in preparing their threaded parts specifications so that such parts may be produced in the most economical manner. The book should be found of considerable value by those who have to do with the design or manufacture of threaded parts.

MATERIAL HANDLING EQUIPMENT. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe, Ohio. Circular entitled "It Couldn't Be Done, But It Was," illustrating the use of the Cleveland tramrail system in textile plants. Bulletin illustrating some of the many types of buckets provided for use with the Cleveland tramrail system. Bulletin treating of the weighing system installed as part of the Cleveland tramrail system of handling materials.

WELDING EQUIPMENT. Linde Air Products Co., 30 E. 42nd St., New York City. Booklet entitled "Design Standards for Oxwelded Steel and Wrought-iron Piping." This booklet is intended to instruct the engineer and architect in designing gas-welded steel or wrought-iron piping systems for any purpose, and covers all the necessary structural details. The booklet has been published to meet the demand created by the extensive application of the welding process to modern piping service.

SMALL TOOLS. Gairing Tool Co., 1629 W. Lafayette Blvd., Detroit, Mich. Catalogue 20, illustrating and describing the Gairing line of small tools, including counterbores, holders, and pilots, spot-facing tools and heads, core drills, reamers, boring heads, multiple-operation tools, form cutters, hollow mills, and grinding fixtures. List prices of the standard tools are included, as well as a section of tables and useful information. Another section of the book shows typical applications of Gairing standard and special tools.

THREAD-CUTTING MACHINERY. Landis Machine Co., Inc., Waynesboro, Pa. Handbook compiled for users and operators of Landis threading equipment and Victor taps. This booklet contains instructions on grinding Landis chasers, operating Landis threading heads and machines, grinding Victor chasers, and operating Victor taps. It also treats briefly of the cutting of special threads with Landis heads. Valuable data has also been compiled relative to special threads encountered in the manufacture of airplanes, automobiles, locomotives, railway cars, machine tools, etc.

PRECISION MEASURING INSTRUMENTS. Gaertner Scientific Corporation, 1201 Wrightwood Ave., Chicago, Ill., Catalogue M-130, covering the line of precision measuring instruments made by this concern, which includes microscopes and accessories; micrometer eye-pieces, slides, and accessories; laboratory telescopes and supports; elevating stands; reading scales; standard meters and scales; comparators; and dividing machines. Bulletin 122, illustrating and describing speed indicators, hand tachometers, vernier calipers, laboratory blow-torches, thermometer and burette readers, and analytical balances.

DIEMAKERS' SUPPLIES. Danly Machine Specialties, Inc., 2112 S. 52nd Ave., Chicago, Ill. Catalogue and data book on die sets and diemakers' supplies. This is the sixth edition of a catalogue covering the complete line of reverse die sets manufactured by this company, together with additional sizes of laps, stripper bolts, and bushings. In the same cover is included a 12-page book on large die sets, covering the new line of four-post and two-post rectangular, four-post square, and three- and two-post long narrow die sets, together with special heavy-duty guide posts and bushings. A chart showing the various sizes and makes of punch presses which may be employed for the different sizes of large die sets is included.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912

of MACHINERY, published monthly at New York, N. Y., for October 1, 1929.

State of New York }
County of New York } ss.

Before me, a Notary Public, in and for the state and county aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the treasurer of the Industrial Press, Publishers of MACHINERY, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Industrial Press, 140-148 Lafayette St., New York; Editor, Erik Oberg, 140-148 Lafayette St., New York; Managing Editor, None; Business Managers, Alexander Luchars, President, 140-148 Lafayette St., New York, Robert B. Luchars, Vice-president, 140-148 Lafayette St., New York, and Edgar A. Becker, Treasurer, 140-148 Lafayette St., New York.

2. That the owners of 1 per cent or more of the total amount of stock are: The Industrial Press; Alexander Luchars; Alexander Luchars, Trustee for Helen L. Ketchum, Elizabeth Y. Urban, and Robert B. Luchars; Nellie I. O'Neill; Louis Pelletier; and Erik Oberg. The address of all the foregoing is 140-148 Lafayette St., New York.

3. That there are no bondholders, mortgagees, or other security holders.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer

Sworn to and subscribed before me this 19th day of September, 1929.

CHARLES P. ABEL,
Notary Public, Kings County No. 228
(SEAL) Kings Register No. 1038
New York County No. 35, New York Register No. 1-A-25
(My commission expires March 30, 1931)